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COMPARATIVE VERIFICATION OF GUIDANCE AND LOCAL AVIATION/PUBLIC WEATHER FORECASTS--NO. 7
(October 1978 - March 1979)

Karl F. Hebenstreit, Joseph R. Bocchieri, Gary M. Carter,
J. Paul Dallavalle, David B. Gilhousen, George W. Hollenbaugh,
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1. INTRODUCTION

This is the seventh in the series of Techniques Development Laboratory (TDL) office notes which compare the performance of TDL's automated guidance forecasts with National Weather Service (NWS) local forecasts made at Weather Service Forecast Offices (WSFO's). The local forecasts, which are produced subjectively, may or may not be based on the automated guidance. We present verification statistics for the cool season months of October 1978 through March 1979 for probability of precipitation, precipitation type, surface wind, opaque sky cover, ceiling height, visibility, and maximum/minimum (max/min) temperature.

The objective guidance is based on equations developed through the Model Output Statistics (MOS) technique (Glahn and Lowry, 1972). We derived these prediction equations by using archived surface observations and forecast fields from the Limited-area Fine Mesh (LFM) model (National Weather Service, 1971), the Trajectory (TJ) model (Reap, 1972), and/or the 6-layer coarse mesh Primitive Equation (6LPE) model (Shuman and Hovermale, 1968). In operations, however, forecast fields from the LFM-II (National Weather Service, 1977a) and the 7-layer PE (7LPE) model (National Weather Service, 1977b) are employed in the MOS guidance equations when LFM or PE data, respectively, are required. Unless indicated otherwise, we usually refer to MOS forecasts based on the LFM-II as "early" guidance; "final" guidance indicates that the objective forecasts were dependent on the 7LPE. Also, the observation times of surface weather elements used as predictors in the early and final guidance generally differ.

The local forecasts from the WSFO's were collected by the Technical Procedures Branch of the Office of Meteorology and Oceanography for the purposes of the NWS combined aviation/public weather verification system (National Weather Service, 1973). These forecasts were recorded for verification according to the direction that they be "...not inconsistent with..." the official weather prognosis. Surface observations as late as 2 hours before the first valid forecast time may have been used in the preparation of the local forecasts. We obtained the observed verification data from the National Climatic Center in Asheville, North Carolina.

2. PROBABILITY OF PRECIPITATION (PoP)

The objective PoP forecasts were produced by the cool season prediction equations described in Technical Procedures Bulletin No. 244 (National

Weather Service, 1978c). Guidance was available for the first, second, and third periods, which correspond to 12-24 hours, 24-36 hours, and 36-48 hours, respectively, after the model input data time (0000 or 1200 GMT). The predictors for the first period equations were forecast fields from the LFM-II model and surface variables observed at the forecast site 3 hours after the initial model time.

Both early and final objective guidance were produced for the second and third periods while only early guidance was available for the first period. All of the early automated forecasts were based on the LFM-II model forecasts. The final guidance for the second period was based on fields from the LFM-II, 7LPE, and TJ models. Third period final guidance equations used 7LPE predictors only.

We verified the forecasts by computing the Brier score (Brier, 1950) for the 87 stations shown in Table 2.1. Please note that we used the standard NWS Brier score which is one-half the original score defined by Brier. Brier scores will naturally vary from one station to the next and from one year to the next because of changes in the relative frequency of precipitation. Therefore, we also computed the percent improvement over climatology, that is, the percent improvement of the Brier scores obtained from the local or guidance forecasts over the Brier scores produced by climatic forecasts. The latter are defined as relative frequencies of precipitation by month and by station determined from a 15-year sample (Jorgensen, 1967).

Table 2.2 shows the results for all 87 stations for 0000 GMT forecasts made during the period October 1978 through March 1979. Tables 2.3 through 2.6 show scores for the NWS Eastern, Southern, Central, and Western Regions, respectively; the second and third period verifications are a three-way comparison between the early and final guidance, and the subjective local forecasts.

A major result of this verification is that NWS forecasters were able to improve upon the early guidance for only the first period. The accuracy of the second and third period early MOS guidance was about the same as that of the local forecasts for all stations combined. When the scores for individual regions were examined, we found the Western Region forecasters scored better than the early guidance for both the second and third periods. In contrast, the early MOS guidance was superior to the local forecasts for these periods in the other three regions.

Another important result is that the early guidance continued to be more accurate than the final guidance for both the second and third periods. The only exception to this occurred in the Western Region where the third period final MOS forecasts were better than the early ones. The superiority of the early over the final guidance has increased since the last cool season (Gilhousen et al., 1979).

Fig. 2.1 shows the trend since 1971 in the accuracy (expressed in terms of percent improvement over climatology) of the first and third period 0000 GMT PoP forecasts. During the 1978-79 cool season, the local forecasts and the final guidance were more accurate for the first period than the previous season. Recall that starting with the cool season 1977-78 the final and early guidance have been identical in the first period. For third period forecasts, the local forecasts and the early guidance were more accurate than the previous season, but the final guidance was less accurate. Several "long term" trends are evident. First, the accuracy of both guidance and local forecasts has increased since the 1973-74 winter season. Secondly, as the 12-24 h MOS guidance has improved, the difference between the guidance and the local forecasts has decreased. Note that results for the 1975-76 season were unavailable because of missing data. In addition, the 1977-78 scores for the third period were based on less than a full season of data.

3. PRECIPITATION TYPE

A new TDL system for predicting the conditional probability of precipitation type (PoPT) (Bocchieri, 1979) was made operational within NWS in September 1978. This system evolved from the probability of frozen precipitation (PoF) system (Glahn and Bocchieri, 1975; Bocchieri and Glahn, 1976; and National Weather Service, 1976) which became operational in November 1972. The PoPT forecasts replaced the PoF forecasts in the MOS early guidance FOUS12 bulletin (National Weather Service, 1978b); the PoF forecasts remain unchanged on the final guidance FOUS22 bulletin.

The PoPT system gives conditional probability forecasts for three precipitation type categories: frozen (snow or ice pellets), freezing (freezing rain or drizzle), and liquid (rain). Precipitation in the form of mixed snow and ice pellets is included in the frozen category; all other mixed precipitation types are included in the liquid category. Here, the frozen, freezing, and liquid categories will be referred to as simply snow, freezing rain, and rain, respectively. The main difference between the PoPT and PoF systems is that freezing rain forecasts aren't explicitly available in PoF, that is, freezing rain is considered as rain in PoF. Another difference is that the PoPT forecasts are transformed so that a "best category" is also provided operationally; in PoF, a categorical forecast isn't available.

In the NWS verification, local categorical forecasts of precipitation type made at about 1000 GMT are recorded for the valid times 1800 GMT (today), 0600 GMT (tonight), and 1800 GMT (tomorrow). Note that this is a conditional forecast, that is, a forecast of type of precipitation if precipitation occurs. Therefore, a precipitation type forecast is always recorded. The PoPT and PoF guidance forecasts are also conditional and are available whether or not precipitation occurs.

Table 3.1 lists the 62 stations used in this verification. We included only cases when precipitation actually occurred. We were concerned that the forecasters may not have put much effort into making the conditional forecasts when they considered precipitation to be unlikely. Therefore, in order to isolate those situations when the forecaster thought precipitation a definite possibility, we used only the cases when the local PoP was $\geq$ 30%. The PoPs were valid for the 12-h periods centered on the 18-, 30-, and 42-h projections used in the verification.

Table 3.2 shows comparative verification results between the early PoPT guidance and the local forecasts for the snow, freezing rain, and rain categories. The manner in which the guidance "best category" is calculated is described in Bocchieri (1979). It should be noted that this was the first season for which freezing rain forecasts were verified. The bias[1] for the freezing rain category is not shown in the regional breakdown because there weren't enough cases to be meaningful. The results, for all stations combined, indicate that: (1) the guidance was slightly better than the local forecasts for percent correct and skill score[2] for the 18-h projection; however, this advantage decreased with increasing projection so that at 42 hours there was little difference between the two; (2) both the guidance and local forecasts slightly overforecast the snow event except at the 18-h projection when the bias for both systems was near 1.00; and (3) the guidance tended to overforecast freezing rain for the 30- and 42-h projections, while the locals overforecasted freezing rain at the 18-h projection but considerably underforecasted this event at the 30- and 42-h projections.

The percent correct and skill scores were very high because the sample included many "obvious" forecasts. For instance, on some days in the southern states, precipitation, if it occurred, would obviously be rain. In order to isolate some of the more difficult forecasting situations, we looked at the cases in which the guidance and locals differed. Again we used only those cases for which local PoPs were $\geq$ 30%. Table 3.3 gives the results. In general, the guidance was correct 51% to 56% of the time, and the locals were correct about 40% of the time.

In order to do a comparative verification among the early PoPT guidance, the final PoF guidance, and the locals, and to compare scores from the 1978-79 season to previous seasons, we also verified two categories of precip type: snow and rain. In this verification, freezing rain was included in the rain category. A PoF categorical forecast of snow was defined as a PoF $\geq$ 50%. In the PoPT system, categorical forecasts of snow were available operationally. In Table 3.4, the verification results, for all stations combined, indicate that: (1) the early guidance was generally better than the final guidance and the local forecasts for all scores and projections; and (2) the final guidance was generally better than the local forecasts except in terms of bias.

The skill scores of the guidance and local forecasts for 6 seasons are shown in Fig. 3.1. Only the 18- and 42-h verification results are presented. Note that some changes in the verification procedure took place during these 6 years. First, the number of stations changed from approximately 90 for the first 2 years to approximately 60 afterwards. Secondly, starting with the 1975-76 season, we used only cases when the local PoP was 30% or greater in

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[1] The bias is the number of forecasts of an event divided by the number of observed events.

[2] The skill score used throughout this paper is the Heidke skill score (Panofsky and Brier, 1965).

order to isolate those cases when the forecaster would have been more confident that precipitation was to occur. Third, starting in the 1976-77 season, we verified the early PoF guidance for the 18-h projection. Finally, in the 1978-79 season, the early PoF system was replaced by the PoPT system, and the PoPT forecasts were verified for both the 18- and 42-h projections.

The results indicate that the guidance was consistently better over the 6 years except during the 1977-78 season when guidance and local forecasts scored the same at the 18-h projection. There was definite improvement, especially for the locals, over the span of the first 4 years. However, the skill of the guidance and locals generally decreased during the last 2 seasons. The observed deterioration of the skill score could have been caused in part by model changes at NMC. The final guidance equations were developed using 6LPE model output, but have been driven by 7LPE model output since January 1978. The early guidance equations operational during 1977-78 were based on LFM model output, but were driven by the LFMII model. By the 1978-79 season we were able to include some LFMII model output in the development of the new early guidance equations. This may account for the fact that the early guidance skill remained unchanged in the face of the otherwise general decrease in skill.

4. SURFACE WIND

The objective wind forecasts were generated by early and final guidance equations valid for the cool season (see National Weather Service, 1979). The definition of the objective surface wind forecast is the same as that of the observed wind: the one-minute average direction and speed for a specific time. Operationally, the early guidance was based on output from the LFM-II model, while the final guidance relied on 7LPE model forecasts. The sine and cosine of the day of the year also were used as predictors in both sets of guidance equations.

Since the local forecasts were recorded as calm if the wind speed was expected to be less than 8 knots, we verified the wind forecasts in two ways. First, for all cases where both the local and guidance (early and final) wind speed forecasts were at least 8 knots, the mean absolute error (MAE) of speed was computed. Secondly, for all cases where both local and guidance forecasts were available, skill score, percent correct, and bias by category (i.e., the number of forecasts in a particular category divided by the number of observations in that category) were computed from contingency tables of wind speed. The seven categories were: less than 8, 8-12, 13-17, 18-22, 23-27, 28-32, and greater than 32 knots. Table 4.1 lists the 94 stations used in the verification. Tables 4.2 - 4.12 show comparative verification scores (0000 GMT cycle only) for 18-, 30-, and 42-h projections. Note that all the objective forecasts of wind speed were adjusted by an "inflation" equation (Klein et al., 1959) involving the multiple correlation coefficient and mean value of wind speed for a particular station and forecast valid time.

The results for all 94 stations combined are shown in Tables 4.2 and 4.3. The MAE scores for direction show that the guidance—particularly the early—was considerably better than the local forecasts. The speed MAE's, skill scores, and percents correct also were better for the guidance. In addition, the early guidance scores were superior to those for the final guidance. Note, however, that the biases by category in Table 4.2 and the contingency tables in Table 4.3 indicate that both types of guidance and the local forecasts tended to underestimate winds stronger than 17 knots (i.e., categories 4, 5, 6, and 7).

Tables 4.4 - 4.7 show scores for the NWS Eastern, Southern, Central, and Western Regions, respectively. The regional values have the same general characteristics as those overall, except the magnitude of the advantage for the guidance over the local forecasts varied from region to region. However, the Western Region scores for wind speed in Table 4.7 indicate that the 18-h local forecasts were as good as the early guidance and slightly better than the final guidance. Also, for the Western Region, the 30- and 42-h final guidance speed forecasts were slightly better than those for the early guidance.

Table 4.8 shows the distribution of wind direction absolute errors by categories--0-30°, 40-60°, 70-90°, 100-120°, 130-150°, and 160-180°--for all 94 stations combined. Here, for the 18-h projection, we see that the early guidance had about 6% fewer errors of 40° or more than did the local forecasts. The final guidance was also superior to the local forecasts in this respect with approximately 3% fewer errors for the same projection. The comparable improvements were 8% and 4%, respectively, for the 30-h projection, and 12% and 7%, respectively, for the 42-h projection.

Distribution of direction errors for the individual regions are given in Tables 4.9 - 4.12. In general, these results are like those in Table 4.8 except, once again, the magnitude of the advantage for the guidance over local forecasts differs from region to region. Here, the results for the Western Region (Table 4.12) show the superiority of the local forecasts over the final guidance for the 42-h projection.

A comparison of the overall MAE's and skill scores for the past 6 cool seasons for 18- and 42-h guidance and local forecasts is presented in Figs. 4.1 - 4.4. In general, the verification data throughout this period were homogeneous, with the exception that the cool season of 1973-74 did not include the month of October. Though the number of stations varied slightly from season to season, the same basic set of verification stations were used. Early guidance scores were available for only the cool seasons of 1976-77, 1977-78, and 1978-79 for the 18-h projection, and 1978-79 for the 42-h projection.

The MAE's for direction are shown in Fig. 4.1. Except for a slight increase in some of the MAE's during 1977-78 cool season, when new forecast models were put into operation, the final guidance and local forecasts for both projections steadily improved over the span of these 6 seasons.

In contrast, the MAE's in Fig. 4.2 indicate a decrease in accuracy for the final guidance speed forecasts between the 1974-75 and 1975-76 cool seasons when inflation was introduced. We knew that the inflation technique would have this effect; however, the bias values shown in Table 4.2 are somewhat closer to 1.0 compared to the bias values in previous cool season surface wind verifications (Carter and Hollenbaugh, 1975). Even so, the MAE's for the guidance are still generally as good as, or better than, those for the local forecasts.

Fig. 4.3 is a comparison of guidance and local skill scores computed on five (instead of seven) categories; the fifth category included all speeds greater than 22 knots. For the first time, the skill scores for the 18-h final guidance and local forecasts were identical, and the skill scores of the 42-h forecasts were nearly the same. The 18-h early guidance forecasts, although declining in skill from last cool season, remained superior to the final guidance and local forecasts. Also, the 42-h early forecasts were considerably better than the locals and final guidance at that projection.

Fig. 4.4 depicts a comparison of guidance and local skill scores computed on two categories; the first category contained all speeds less than or equal to 22 knots, while the second category included speeds greater than 22 knots. In this manner, we attempted to directly assess the skill of the guidance and local forecasts in regard to predicting strong winds. Similar to the results in Fig. 4.3, the skill of the final guidance for the 18- and 42-h projections increased during the first 5 years, but decreased this past cool season. In contrast, the local forecasts for the 42-h projection showed very little improvement throughout the 6 year period.

The 18- and 42-h early guidance MAE's and skill scores in Figs. 4.1 - 4.3 generally indicate the superiority of the early over the final guidance. This is quite encouraging because the early guidance is now the only source of detailed surface wind guidance available to NWS field forecasters prior to issuance of the public weather forecast.

5. OPAQUE SKY COVER

The operational prediction equation set was unchanged for the 1978-79 cool season. The early guidance set uses LFM-II model output and 0300 (1500) GMT surface observations to produce forecasts at 6 hour intervals from 6 to 48 hours after 0000 (1200) GMT. The final set uses LFM-II and 7LPE model output and 0600 (1800) GMT surface observations to produce forecasts at 6-hour intervals from 12 to 48 hours after 0000 (1200) GMT.

The regionalized equations produce probability forecasts of four categories of opaque sky cover, more commonly known as cloud amount, as shown in Table 5.1. For both the early and final guidance packages, we convert the probability estimates to a single "best category" forecast in a manner which produces good bias characteristics, that is, a bias value of approximately 1.0 for each category. For more details about our cloud amount forecast system, see Technical Procedures Bulletin No. 234 (National Weather Service, 1978a).

We compared the local forecasts at the 94 stations listed in Table 3.1 with a matched sample of early and final objective forecasts. The comparison was conducted for 18-, 30-, and 42-h forecasts from the 0000 GMT cycle only. The local forecasts and the surface observations used for verification were converted from opaque sky cover amount to the categories in Table 5.1. Four-category, forecast-observed contingency tables were prepared from the transformed local and best-category objective predictions. Using these tables, we computed the percent correct, Heidke skill score, and bias by category.

The results for all stations combined are shown in Table 5.2. There was only a slight difference in the scores for the guidance forecasts. Clearly, in terms of the percent correct and skill scores, both the early and final guidance were superior to the local forecasts at all projections. Also, the bias-by-category scores of the guidance forecasts were better (closer to 1.0) than those of the local forecasts which exhibited a strong tendency to overforecast the scattered and broken categories.

The verification scores for stations in the NWS Eastern, Southern, Central, and Western Regions are given in Tables 5.3 through 5.6, respectively. In each case the difference in the performance of the early and final guidance was slight at all projections. The Western Region at the 18-h projection provided the only instance where the skill of the local forecasts exceeded that of the guidance. The bias scores for the local forecasts in the regional breakdown show that the general tendency to overforecast scattered and broken conditions occured in all regions.

The percent correct and skill scores over the past 5 cool seasons are shown in Figs. 5.1 and 5.2, respectively, for the 18- and 42-h projections. These figures show that the guidance has improved slightly with time and that the relative superiority of the guidance over the local forecasts is increasing.

Figs. 5.3 and 5.4 show the biases for categories 1 and 2, respectively, for the 18- and 42-h projections. These figures show that the bias characteristics of the guidance have remained superior to those of the local forecasts. The local forecasts underforecast the clear category (category 1) and overforecast the scattered category (category 2).

6. CEILING AND VISIBILITY

For the 1978-79 cool season, we used the ceiling and visibility prediction equations from the previous cool season. Operationally, the early guidance set is driven by LFM-II model output and uses 0300 (1500) GMT surface observations. The final guidance set uses both LFM-II and 7LPE model output and the 0600 (1800) GMT surface observations. The early guidance consists of forecasts at 6-h intervals from 6 to 48 hours after cycle time; the final guidance, from 12 to 48 hours after cycle time. For details concerning the ceiling and visibility forecast system see Technical Procedures Bulletin No. 234 (National Weather Service, 1978a).

Our ceiling and visibility verification procedure continues to track the performance of a number of scores for both subjective local forecasts and objective guidance forecasts. In each case a persistence observation (taken at 0900 GMT for the 0000 GMT cycle and at 2100 or 2200 GMT for the 1200 GMT cycle) provides a comparison. Early and final guidance forecasts are verified for both cycles at the 12-, 18-, 24-, 36-, and 48-h projections and local forecasts for 12-, 15-, and 21-h projections. The guidance and the persistence observation are usually available to the local forecaster.

We constructed six-category (Table 6.1) forecast-observed contingency tables for all the forecasts involved in the comparative verification. These categories were then used for computing several different scores: bias-by-category, percent correct, and Heidke skill score. We then collapsed the tables to two categories (categories 1 and 2 combined versus categories 3 through 6 combined) and calculated the bias and threat score for categories 1 and 2 combined and the Heidke skill score and percent correct for the reduced tables. We have summarized the results in Tables 6.2 - 6.9. The Heidke skill score and bias for categories 1 and 2 combined are also given in Tables 6.10 - 6.17 for the last 4 cool seasons.

Tables 6.2 - 6.5 present the results for the six-category ceiling and visibility forecasts for all 94 stations (see Table 3.1) combined and Tables 6.6 - 6.9 provide scores for categories 1 and 2 combined (i.e. ceilings less than 500 feet and visibilities less than 1 mile). Note that the six-category guidance was usually more skillful than persistence for projections beyond the 12-h projection (the exception was for the 18-h projection for visibility during the 1200 GMT cycle). The two-category skill scores show that the early guidance was generally poorer than persistence at the 18-h projection. The skill of local forecasts for both the six- and two-category tables exceeded that of the guidance at the 12-h projection, but never exceeded the skill of persistence (which is available to the local forecaster) for that projection. At the 15- and 21-h projections, the six-category skill of the locals was greater than that of persistence except for visibility at 15-h from the 1200 GMT cycle. The skill scores from the two-category tables show that the locals failed to beat persistence at 15- and 21-h for ceiling forecasts from the 0000 GMT cycle. Also, at the 12-h projection, final guidance, which uses the 0600 (1800) GMT surface observation, was consistently more skillful than early guidance, which uses the 0300 (1500) GMT surface observations. These results reflect the well-known decay with time in skill of forecasts made from the latest observation. We note little difference in skill between the early and final guidance at the longer projections.

The purpose of using the threshold probability technique to select the "best" category for ceiling and visibility was to improve the bias characteristics of the guidance forecasts. The bias-by-category scores show that for most projections the guidance had better bias scores than either the local or persistence forecasts. The biases of the 36-h persistence forecasts (actually a 27-h projection) should be as good as those of 12-h persistence (actually a 3-h projection). Tables 6.2 - 6.9 show this to be true.

Tables 6.10 through 6.13 present the Heidke skill scores computed from two-category contingency tables and Tables 6.14 through 6.17, the bias of categories 1 and 2 combined for the last 4 cool seasons. Figs. 6.1 - 6.7 present selected portions of these data for the 0000 GMT cycle for projections of 12, 15, 18, and 21 hours. The sample size for the 1976-77 cool season was relatively small (Feb. 8 - March 31) which may be a contributing factor to the flucuations in most of the graphs for that season. In general, these data show that the guidance bias characteristics for the difficult-to-forecast low categories have improved with the adoption of the threshold technique during the 1976-77 cool season. At the same time, the skill scores for the guidance have improved slightly over those of 1975-76, but exhibit variation from year to year.

7. MAX/MIN TEMPERATURE

The objective max/min guidance for the October 1978 through March 1979 cool season was produced by several different sets of seasonal regression equations. However, the predictand for both the early and final guidance was the local calendar day max or min valid approximately 24, 36, 48, or 60 hours after initial model time (0000 GMT or 1200 GMT). The final guidance was based on equations developed by stratifying archived 6LPE and TJ model output, station observations, and the first two harmonics of the day of the year into seasons of 3-month duration (Hammons et al., 1976). We used fall (September-November), winter (December-February), and spring (March-May) equations to produce the final guidance during the appropriate months of the 1978-79 cool season. Operationally, the equations employed output from the 7LPE and the TJ models as predictors. Station observations available 6 hours after the initial model time also were included in the final guidance equations for the first two projections.

In contrast, the early guidance system depended on new prediction equations (Carter et al., 1978) derived from LFM model output, station observations available 3 hours after initial model time, and the first two harmonics of the day of the year. This was the first cool season in which LFM-derived equations were available for 3-month seasons: fall (October-December) and winter (January-March). For the remaining projections, however, data were sufficient only for 6-month season equations. Thus, to produce the early guidance for the second, third, and fourth projections, we used cool season (October-March) equations. In operations, forecast fields from the LFM-II were employed as predictors in the LFM-derived equations. Surface observations at 3 hours after the initial model time were included as input for many of the forecast equations for the first two periods.

The objective guidance--both early and final--is available on the FOUS22 teletype bulletin while the local forecasts are on the FPUS4 teletype message. As mentioned earlier, the automated max/min forecasts refer to the 24-h interval of the local calendar day. Thus, for example, the first period objective forecasts of the max based on 0000 GMT model data (Day 1) is valid for the calendar day that starts before 1200 GMT (Day 1) and ends after 0000 GMT the following day (Day 2). However, the valid period of the local max/min forecast does not correspond to the calendar day. Rather, the local forecaster predicts a max for the 1200 to 0000 GMT interval and a min that is generally valid from 0000 to 1200 GMT. This latter time, however, is extended to 1800 GMT for forecasters in the Western Region and for many others in the western parts of the Central and Southern Regions. Hence, caution is necessary in comparing verification scores for the local forecasts and the objective guidance.

We verified local and objective forecasts from the 0000 GMT cycle, using calendar day max and min obtained from the National Climatic Center as the verifying observations. Mean algebraic error (forecast minus observed temperature), mean absolute error, and the number of absolute errors greater than 10°F were computed for 87 stations (Table 2.1) in the conterminous United States. Four forecast projections of approximately 24 (max), 36 (min), 48 (max), and 60 (min) hours after 0000 GMT were verified.

Verification results are shown in Table 7.1 for all stations combined. For the two projections of the max, the early guidance had a mean algebraic error of 0.0°F while the final guidance tended towards a cold bias (algebraic error < 0.0°F). In contrast, both the early and final min guidance were too warm (algebraic error > 0.0°F). Note that the local forecasts exhibited the same type of algebraic errors as the MOS guidance; for all projections, however, the local bias was more pronounced.

At all projections but the last, the early guidance was more accurate than the final in terms of mean absolute error. This was a dramatic reversal from the 1977-78 cool season (Gilhousen et al., 1979) when the final was consistently better than the early guidance. Even in the last projection, the early guidance was only 0.1°F less accurate in mean absolute error than the final. We believe that the new LFM-derived equations (Carter et al., 1978) were the primary cause for the improvement in the early guidance. Unfortunately, there was also a serious error in the 7LPE-based TJ model which contaminated the final guidance during December, January, and February. We're unable to estimate the amount of deterioration that this caused. Note that there were only small differences in the accuracy of the local forecasts and the early guidance. While the local forecasts improved on the early guidance by 0.1°F mean absolute error in three of the four projections, for the 36-h min the early guidance actually had fewer large absolute errors (> 10.0°F) than the local forecasters.

It is of some interest to compare the accuracy of this year's forecasts with that of the 1977-78 cool season (Gilhousen et al., 1979). For the max forecasts, the local and the early guidance for the 1978-79 season had nearly the same mean absolute errors as the local and final guidance of last season. In contrast, however, this year's local and early forecasts of the min were noticeably (0.3°F mean absolute error) less accurate than were the locals and final guidance for last season. Natural variability in meteorological conditions and, consequently, in the difficulty of forecasting the min would seem to explain this deterioration. We also examined verification scores for the Eastern, Southern, Central, and Western Regions (Tables 7.2 - 7.5, respectively). The improvement of the early guidance relative to the final guidance was generally evident on a regional basis. For both the Eastern and Southern Regions, in terms of mean absolute error, the early guidance was as accurate as, or more accurate than, the final guidance for all four projections. In the Central Region, the mean absolute error of the early guidance was less than that of the final guidance at all projections but the last. Finally, even in the Western Region, the early guidance was as accurate as the final for the 36- and 48-h projections. For the remaining two projections, the differences between the early and final guidance were small. This contrasts sharply with the 1977-78 cool season (Gilhousen et al., 1979) when the early guidance in the Western Region was quite inferior to the final guidance at all projections. Finally, both sets of objective guidance had a warm bias in the Western Region at all projections.

The accuracy of the local forecasts relative to the objective guidance also varied from region to region. In the Eastern and Southern Regions, there were only small differences in mean absolute error between the early guidance and the local forecasts. In contrast, on the basis of mean absolute errors, forecasters in the Central Region improved over the early guidance in all projections, though the margins were generally small. Finally, the Western Region forecasters were more accurate than either the early or final guidance for both the 24- and 48-h max. For the 36-h min, however, the early guidance had a smaller mean absolute error (by 0.2°F) than the local forecasts.

The mean absolute errors (0000 GMT cycle only) during the last 8 cool seasons are given in Fig. 7.1 for the max forecasts. For both the local forecasts and the final guidance, there has been an overall increase in accuracy since the 1971-72 cool season. The greatest improvement in the objective guidance occurred in the 1973-74 cool season when we implemented the first MOS forecast equations which were based on 6-month seasons (Klein and Hammons, 1975). Note, too, that the difference in skill between the local forecasts and the final guidance has remained relatively constant since the 1973-74 cool season; however, the introduction of LFM-derived early guidance in the 1978-79 cool season narrowed the gap between the local forecasts and the guidance.

An analagous time series is shown in Fig. 7.2 for the min forecasts. Verifications for the 60-h projection are available only for the last 2 seasons. For the 36-h projection, there has been an overall improvement in the objective guidance since the 1971-72 cool season. It is difficult to discern a corresponding trend in the accuracy of the local forecasts. As we mentioned earlier, natural variability and the difficulty of predicting the min is important in understanding these curves. Unlike the max, however, the objective min guidance showed its greatest improvement in the 1975-76 cool season when we switched from 6-month to 3-month MOS forecast equations (Hammons et al., 1976). Note that for both the 36- and 60-h projections, the local forecasters and the objective guidance have approximately the same level of skill.

8. CONCLUSIONS

TDL's aviation/public weather guidance forecasts, as measured by the various scores used in this ongoing verification program, continue to compare favorably with local forecasts produced at WSFO's. For PoP forecasts, the NWS forecasters outperformed the early guidance only in the first period. Also, early guidance PoP forecasts continued to be more accurate than the final for both the second and third periods (except the third period in the Western Region). Finally, "long term" trends show that both guidance and local PoP forecasts are improving, with the guidance improving at a slightly faster rate than the locals in the first period.

There was a major change in the precipitation type forecasting system with PoPT forecasts replacing PoF in the early guidance. Overall, in bias, percent correct, and skill score the guidance continued to perform as well as or slightly better than the locals at all projections. The skill of both the guidance and local forecasts of frozen precipitation generally exhibited a downward trend over the past two years, except that the skill of the 18-h early guidance remained level in the face of this general downward trend.

For the surface wind forecasts, the performance of the MOS guidance (as measured by various scores) for all stations combined continued to exceed that of the locals. Also, the early guidance outperformed the final guidance.

However, on a regional basis, the results showed the Western Region forecasters were able to improve on the guidance in many cases. Trends show that the MAE for direction has improved steadily, while MAE for speed jumped in the 1975-76 cool season due to the use of the inflation procedure. This technique, however, did produce better bias characteristics for the guidance. Five-category wind speed results show that the skill of the local forecasts was approximately equal to the skill of the final guidance. In contrast, the early guidance was considerably better than the local forecasts. We note a decline in the skill of both the two-category and five-category during the past two cool seasons. However, overall, the skill of the guidance still exceeded that of the locals.

The various performance measures show that both the early and final opaque sky cover guidance forecasts were more accurate than the local forecasts. Early and final guidance performed equally well at the 3 projections examined. The bias characteristics of the guidance were better than the local forecasts which tended to overforecast scattered and broken conditions. The trend showed an improvement in the guidance at both the 18- and 42-h projections.

A direct comparison between local, MOS guidance, and persistence forecasts for ceiling and visibility was possible only at the 12-h projection. At this projection, the local forecasts were more skillful than the guidance, but in both the two- and six-category comparison, persistence was more skillful than the local forecasts. The long term trend generally shows a disappointing decrease of skill in forecasting low conditions for both early and final guidance, especially pronounced at the 36- and 48-h projections. The bias characteristics of the guidance continued to be generally better than those of the locals in the lower categories where the local forecasts underforecast the occurrence of these events.

Finally, for max/min temperature, new early guidance equations were implemented during the 1978-79 cool season. As a result, the early max/min guidance was more accurate than the final at the first three projections. For the 60-h min forecast, however, the final guidance had lower mean absolute errors. These trends were generally evident in the four NWS regions discussed in this report. Though comparisons between the objective guidance and the local forecasts of the max/min are difficult to make because of the different forecast periods involved, we found that the local forecasts of the max valid approximately 24- and 48-h after 0000 GMT were slightly more accurate in mean absolute error than the objective guidance. The min is particularly difficult to predict during the cool season, and in fact, there was little or no difference in mean absolute error between the guidance and local forecasts for the 36- and 60-h min.

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Table 2.1. Eighty-seven stations used for comparative verification of guidance and local PoP and max/min temperature forecasts.

AVL	Asheville, North Carolina	DFW	Ft. Worth, Texas
RDU	Raleigh-Durham, North Carolina	JAN	Jackson, Mississippi
ORF	Norfolk, Virginia	MIA	Miami, Florida
PHL	Philadelphia, Pennsylvania	ORL	Orlando, Florida
RIC	Richmond, Virginia	TPA	Tampa, Florida
DCA	Washington, D.C.	MSY	New Orleans, Louisiana
CRW	Charleston, West Virginia	BRO	Brownsville, Texas
CHS	Charleston, South Carolina	SAT	San Antonio, Texas
CLT	Charlotte, North Carolina	IAH	Houston, Texas
CAE	Columbia, South Carolina	ATL	Atlanta, Georgia
LGA	New York (Laguardia), New York	BHM	Birmingham, Alabama
BUF	Buffalo, New York	JAX	Jacksonville, Florida
ALB	Albany, New York	MEM	Memphis, Tennessee
BOS	Boston, Massachusetts	SHV	Shreveport, Louisiana
BDL	Hartford, Connecticut	AUS	Austin, Texas
BTV	Burlington, Vermont	LIT	Little Rock, Arkansas
PWM	Portland, Maine	OKC	Oklahoma City, Oklahoma
PVD	Providence, Rhode Island	TUL	Tulsa, Oklahoma
SYR	Syracuse, New York	MAF	Midland, Texas
CLE	Cleveland, Ohio	ELP	El Paso, Texas
CMH	Columbus, Ohio	AMA	Amarillo, Texas
BWI	Baltimore, Maryland	ABQ	Albuquerque, New Mexico
ACY	Atlantic City, New Jersey	FLG	Flagstaff, Arizona
CVG	Cincinnatti, Ohio	TUS	Tucson, Arizona
DAY	Dayton, Ohio	LAS	Las Vegas, Nevada
PIT	Pittsburgh, Pennsylvania	LAX	Los Angeles, California
ICT	Wichita, Kansas	RNO	Reno, Nevada
MCI	Kansas City, Missouri	SAN	San Diego, California
STL	St. Louis, Missouri	SFO	San Francisco, California
MDW	Chicago (Midway), Illinois	BIL	Billings, Montana
MKE	Milwaukee, Wisconsin	SLC	Salt Lake City, Utah
SSM	Sault Ste Marie, Michigan	BOI	Boise, Idaho
DLH	Duluth, Minnesota	HLN	Helena, Montana
FAR	Fargo, North Dakota	GEG	Spokane, Washington
MSP	Minneapolis, Minnesota	PDX	Portland, Oregon
DSM	Des Moines, Iowa	SEA	Seattle-Tacoma, Washington
OMA	Omaha, Nebraska	CPR	Casper, Wyoming
FSD	Sioux Falls, South Dakota	RAP	Rapid City, South Dakota
DEN	Denver, Colorado	IND	Indianapolis, Indiana
BIS	Bismarck, North Dakota	SDF	Louisville, Kentucky
CYS	Cheyenne, Wyoming	DTW	Detroit, Michigan
LBF	North Platte, Nebraska	PHX	Phoenix, Arizona
BNA	Nashville, Tennessee	GTF	Great Falls, Montana
TOP	Topeka, Kansas		

Table 2.2 Comparative verification of early and final guidance and local PoP forecasts for 87 stations, 0000 GMT cycle.

Projection	Type of Forecast	Brier Score	Improvement Over Guidance (%)	Improvement Over Climatology (%)	Number of Cases
12-24 h (1st period)	Early/Final	.0916		43.3	13906
	Local	.0879	4.0	45.7	
24-36 h (2nd period)	Early	.1069		36.3	13953
	Final	.1158		31.0	
	Local	.1093	-0.2[1] (5.6)	34.8	
36-48 h (3rd period)	Early	.1146		29.6	14038
	Final	.1217		25.3	
	Local	.1147	0.0[1] (5.8)	29.6	

[1] This is the percent improvement of the locals over the early guidance; the figure in parentheses is the percent improvement of the locals over the final guidance.

Table 2.3 Same as Table 2.2 except for 26 stations in the Eastern Region.

Projection	Type of Forecast	Brier Score	Improvement Over Guidance (%)	Improvement Over Climatology (%)	Number of Cases
12-24 h (1st period)	Early/Final	.0949	0.1	49.0	4015
	Local	.0943		49.4	
24-36 h (2nd period)	Early	.1053	-3.3^{1} (9.2)	43.8	4041
	Final	.1197		36.1	
	Local	.1087		41.9	
36-48 h (3rd period)	Early	.1196	-0.6^{1} (8.6)	36.9	4059
	Final	.1316		30.5	
	Local	.1203		36.5	

1 This is the percent improvement of the locals over the early guidance; the figure in parentheses is the percent improvement of the locals over the final guidance.

Table 2.4 Same as Table 2.2 except for 23 stations in the Southern Region.

Projection	Type of Forecast	Brier Score	Improvement Over Guidance (%)	Improvement Over Climatology (%)	Number of Cases
12-24 h (1st period)	Early/Final	.0863		38.8	3699
	Local	.0796	7.8	43.6	
24-36 h (2nd period)	Early	.1045		31.3	3708
	Final	.1136		24.9	
	Local	.1085	-3.8[1] (4.5)	28.3	
36-48 h (3rd period)	Early	.1059		25.6	3727
	Final	.1157		18.8	
	Local	.1091	-3.0[1] (5.7)	23.4	

1 This is the percent improvement of the locals over the early guidance; the figure in parentheses is the percent improvement of the locals over the final guidance.

Table 2.5 Same as Table 2.2 except for 22 stations in the Central Region.

Projection	Type of Forecast	Brier Score	Improvement Over Guidance (%)	Improvement Over Climatology (%)	Number of Cases
12-24 h (1st period)	Early/Final	.0894		44.5	3655
	Local	.0882	1.3	45.2	
24-36 h (2nd period)	Early	.1153		35.7	3660
	Final	.1232		31.2	
	Local	.1187	-2.9[1] (3.7)	33.7	
36-48 h (3rd period)	Early	.1165		28.5	3678
	Final	.1227		24.7	
	Local	.1174	-0.8[1] (4.3)	27.9	

1 This is the percent improvement of the locals over the early guidance; the figure in parentheses is the percent improvement of the locals over the final guidance.

Table 2.6 Same as Table 2.2 except for 16 stations in the Western Region.

Projection	Type of Forecast	Brier Score	Improvement Over Guidance (%)	Improvement Over Climatology (%)	Number of Cases
12-24 h (1st period)	Early/Final	.0973		39.0	2537
	Local	.0894	8.1	43.9	
24-36 h (2nd period)	Early	.1010		32.5	2544
	Final	.1022		31.5	
	Local	.0977	3.3[1] (4.4)	34.5	
36-48 h (3rd period)	Early	.1168		25.1	2574
	Final	.1131		27.6	
	Local	.1101	5.7[1] (2.7)	29.5	

1 This is the percent improvement of the locals over the early guidance; the figure in parentheses is the percent improvement of the locals over the final guidance.

Table 3.1. Sixty-two stations used for comparative verification of guidance and local precipitation type forecasts.

PWM	Portland, Maine	OKC	Oklahoma City, Oklahoma
BTV	Burlington, Vermont	ABQ	Albuquerque, New Mexico
BOS	Boston, Massachusetts	GTF	Great Falls, Montana
PVD	Providence, Rhode Island	DTW	Detroit, Michigan
BUF	Buffalo, New York	IND	Indianapolis, Indiana
SYR	Syracuse, New York	SDF	Louisville, Kentucky
ALB	Albany, New York	MKE	Milwaukee, Wisconsin
PIT	Pittsburgh, Pennsylvania	STL	St. Louis, Missouri
PHL	Philadelphia, Pennsylvania	MCI	Kansas City, Missouri
CLE	Cleveland, Ohio	TOP	Topeka, Kansas
CMH	Columbus, Ohio	DEN	Denver, Colorado
CRW	Charleston, West Virginia	CYS	Cheyenne, Wyoming
DCA	Washington, D.C.	BIS	Bismarck, North Dakota
ORF	Norfolk, Virginia	FAR	Fargo, North Dakota
RDU	Raleigh-Durham, North Carolina	RAP	Rapid City, South Dakota
CLT	Charlotte, North Carolina	FSD	Sioux Falls, South Dakota
CAE	Columbia, South Carolina	OMA	Omaha, Nebraska
ATL	Atlanta, Georgia	MSP	Minneapolis, Minnesota
MIA	Miami, Florida	DSM	Des Moines, Iowa
JAX	Jacksonville, Florida	FLG	Flagstaff, Arizona
BHM	Birmingham, Alabama	PHX	Phoenix, Arizona
MEM	Memphis, Tennessee	SLC	Salt Lake City, Utah
JAN	Jackson, Mississippi	LAS	Las Vegas, Nevada
MSY	New Orleans, Louisiana	RNO	Reno, Nevada
SHV	Shreveport, Louisiana	SAN	San Diego, California
IAH	Houston, Texas	LAX	Los Angeles, California
SAT	San Antonio, Texas	SFO	San Francisco, California
DFW	Fort Worth, Texas	PDX	Portland, Oregon
ELP	El Paso, Texas	SEA	Seattle (Tacoma), Washington
LIT	Little Rock, Arkansas	GEG	Spokane, Washington
TUL	Tulsa, Oklahoma	BOI	Boise, Idaho

Table 3.2. Comparative verification of early PoPT guidance and local forecasts by NWS Region, 0000 GMT cycle. Only cases when local PoP was ≥ 30% are included.

Projection (h)	Region	Type of Fcst.	Bias: Snow	Bias: Freezing Rain	Bias: Rain	Percent Correct	Skill Score	Number of Cases
18	Eastern	Early	1.07	--	.94	91	.82	373
		Local	1.03	--	.97	90	.81	
	Southern	Early	.72	--	1.03	94	.78	164
		Local	.60	--	1.04	93	.73	
	Central	Early	1.04	--	.98	89	.77	255
		Local	1.03	--	.93	85	.70	
	Western	Early	.95	--	1.04	91	.83	162
		Local	.90	--	1.11	90	.79	
	All Stations	Early	1.02	1.00	.99	91	.82	954
		Local	.98	1.38	1.00	89	.79	
30	Eastern	Early	1.08	--	.94	85	.74	349
		Local	1.05	--	.99	86	.73	
	Southern	Early	1.08	--	1.00	89	.50	155
		Local	1.23	--	.98	88	.51	
	Central	Early	1.03	--	.89	86	.73	282
		Local	1.11	--	.86	84	.68	
	Western	Early	1.04	--	.98	91	.82	148
		Local	1.09	--	.96	87	.74	
	All Stations	Early	1.05	1.11	.95	87	.76	934
		Local	1.09	.68	.96	86	.74	
42	Eastern	Early	1.11	--	.84	83	.68	353
		Local	1.11	--	.93	86	.72	
	Southern	Early	.94	--	1.02	92	.67	135
		Local	.65	--	1.05	87	.44	
	Central	Early	1.10	--	.85	85	.69	240
		Local	1.06	--	.98	85	.69	
	Western	Early	1.13	--	.93	89	.77	139
		Local	1.08	--	.98	90	.79	
	All Stations	Early	1.10	1.50	.90	86	.73	867
		Local	1.06	.55	.98	86	.73	

Table 3.3 Comparative verification of early PoPT guidance and local forecasts, 0000 GMT cycle. Only those cases in which the locals and guidance differed, and the local PoP was ≥ 30% were included.

Projection (h)	Type of Forecast	Percent Correct	Number of Cases
18	Early Local	56 38	90
30	Early Local	51 42	104
42	Early Local	56 38	90

Table 3.4 Comparative verification of early PoPT guidance, final PoF guidance, and local forecasts by NWS Region, 0000 GMT cycle. Only cases when local PoP was ≥ 30% were included.

Projection (h)	Region	Type of Fcst.	Bias Snow	Bias Rain	Percent Correct	Skill Score	Number of Cases
18	Eastern	Early	1.07	.95	93	.86	373
		Final	1.14	.90	92	.84	
		Local	1.03	.98	91	.83	
	Southern	Early	.72	1.05	96	.81	164
		Final	.80	1.04	91	.61	
		Local	.60	1.07	94	.72	
	Central	Early	1.04	.93	91	.81	255
		Final	1.12	.80	89	.75	
		Local	1.03	.95	88	.74	
	Western	Early	.95	1.05	93	.85	162
		Final	1.04	.96	92	.84	
		Local	.90	1.09	90	.80	
	All Stations	Early	1.02	.99	93	.86	954
		Final	1.09	.93	91	.82	
		Local	.98	1.02	91	.81	
30	Eastern	Early	1.08	.94	89	.78	349
		Final	1.11	.92	89	.77	
		Local	1.05	.97	88	.76	
	Southern	Early	1.00	1.00	95	.66	155
		Final	1.08	.99	94	.64	
		Local	1.23	.98	94	.66	
	Central	Early	1.03	.96	88	.74	282
		Final	1.11	.84	89	.76	
		Local	1.11	.83	86	.71	
	Western	Early	1.04	.98	92	.83	148
		Final	.96	1.02	88	.74	
		Local	1.09	.95	87	.73	
	All Stations	Early	1.05	.96	90	.79	934
		Final	1.09	.94	89	.78	
		Local	1.09	.94	88	.76	
42	Eastern	Early	1.11	.92	88	.77	353
		Final	1.24	.83	87	.74	
		Local	1.11	.92	88	.75	
	Southern	Early	.94	1.01	95	.76	135
		Final	.82	1.03	93	.67	
		Local	.65	1.05	91	.52	
	Central	Early	1.10	.84	87	.72	240
		Final	1.20	.70	87	.72	
		Local	1.06	.92	86	.70	
	Western	Early	1.13	.92	91	.81	139
		Final	1.11	.93	91	.82	
		Local	1.08	.95	91	.82	
	All Stations	Early	1.10	.92	89	.79	867
		Final	1.19	.87	89	.77	
		Local	1.06	.96	88	.76	

Table 4.1. Ninety-four stations used for comparative verification of guidance and local surface wind, sky cover, ceiling, and visibility forecasts.

PWM	Portland, Maine	GTF	Great Falls, Montana
BTV	Burlington, Vermont	TCC	Tucumcari, New Mexico
CON	Concord, New Hampshire	APN	Alpena, Michigan
BOS	Boston, Massachusetts	DTW	Detroit, Michigan
PVD	Providence, Rhode Island	SBN	South Bend, Indiana
BUF	Buffalo, New York	IND	Indianapolis, Indiana
SYR	Syracuse, New York	LEX	Lexington, Kentucky
ALB	Albany, New York	SDF	Louisville, Kentucky
JFK	New York (Kennedy), New York	MSN	Madison, Wisconsin
EWR	Newark, New Jersey	MKE	Milwaukee, Wisconsin
ERI	Erie, Pennsylvania	ORD	Chicago (O'Hare), Illinois
IPT	Williamsport, Pennsylvania	SPI	Springfield, Illinois
PIT	Pittsburgh, Pennsylvania	STL	St. Louis, Missouri
PHL	Philadelphia, Pennsylvania	MCI	Kansas City, Missouri
CLE	Cleveland, Ohio	TOP	Topeka, Kansas
CMH	Columbus, Ohio	DDC	Dodge City, Kansas
HTS	Huntington, West Virginia	DEN	Denver, Colorado
CRW	Charleston, West Virginia	GJT	Grand Junction, Colorado
DCA	Washington, D.C.	SHR	Sheridan, Wyoming
ORF	Norfolk, Virginia	CYS	Cheyenne, Wyoming
RDU	Raleigh-Durham, North Carolina	BIS	Bismarck, North Dakota
CLT	Charlotte, North Carolina	FAR	Fargo, North Dakota
GSP	Greenville, South Carolina	RAP	Rapid City, South Dakota
CAE	Columbia, South Carolina	FSD	Sioux Falls, South Dakota
ATL	Atlanta, Georgia	BFF	Scottsbluff, Nebraska
SAV	Savannah, Georgia	OMA	Omaha, Nebraska
MIA	Miami, Florida	MSP	Minneapolis, Minnesota
JAX	Jacksonville, Florida	DSM	Des Moines, Iowa
BHM	Birmingham, Alabama	BRL	Burlington, Iowa
MOB	Mobile, Alabama	INL	International Falls, Minnesota
TYS	Knoxville, Tennessee	FLG	Flagstaff, Arizona
MEM	Memphis, Tennessee	PHX	Phoenix, Arizona
MEI	Meridian, Mississippi	CDC	Cedar City, Utah
JAN	Jackson, Mississippi	SLC	Salt Lake City, Utah
MSY	New Orleans, Louisiana	LAS	Las Vegas, Nevada
SHV	Shreveport, Louisiana	RNO	Reno, Nevada
IAH	Houston, Texas	SAN	San Diego, California
SAT	San Antonio, Texas	LAX	Los Angeles, California
DFW	Dallas-Fort Worth, Texas	FAT	Fresno, California
ABI	Abilene, Texas	SFO	San Francisco, California
LBB	Lubbock, Texas	PDX	Portland, Oregon
ELP	El Paso, Texas	PDT	Pendleton, Oregon
LIT	Little Rock, Arkansas	SEA	Seattle (Tacoma), Washington
FSM	Fort Smith, Arkansas	GEG	Spokane, Washington
TUL	Tulsa, Oklahoma	BOI	Boise, Idaho
OKC	Oklahoma City, Oklahoma	PIH	Pocatello, Idaho
ABQ	Albuquerque, New Mexico	MSO	Missoula, Montana

Table 4.2. Comparative verification of early and final guidance and local surface wind forecasts for 94 stations, 0000 GMT cycle.

FCST PROJ (HOURS)	TYPE OF FCST	DIRECTION		SPEED													
								CONTINGENCY TABLE									
										BIAS-NO. FCST/NO. OBS							
		MEAN ABS ERROR (DEG)	NO. OF CASES	MEAN ABS ERROR (KTS)	MEAN FCST (KTS)	MEAN OBS (KTS)	NO. OF CASES	SKILL SCORE	PERCENT FCST CORRECT	CAT1 (NO. OBS)	CAT2 (NO. OBS)	CAT3 (NO. OBS)	CAT4 (NO. OBS)	CAT5 (NO. OBS)	CAT6 (NO. OBS)	CAT7 (NO. OBS)	NO. OF CASES
18	EARLY	24		3.2	12.6			0.32	55	1.20	0.96	0.80	0.60	0.59	0.70	0.20	
	FINAL	26	5542	3.4	12.7	12.9	5584	0.30	54	1.18	0.97	0.83	0.60	0.55	0.65	0.20	13403
	LOCAL	28		3.5	13.7			0.30	51	0.80 (5340)	1.19 (4635)	1.18 (2412)	0.80 (811)	0.65 (172)	1.00 (23)	0.70 (10)	
30	EARLY	30		3.6	12.1			0.38	63	1.06	1.00	0.85	0.50	0.47	0.0	0.0	
	FINAL	33	3160	3.8	12.1	11.6	3198	0.31	62	1.10	0.91	0.78	0.63	0.49	0.38	0.50	13070
	LOCAL	36		3.9	12.7			0.27	57	0.90 (7623)	1.26 (3610)	0.99 (1387)	0.69 (375)	0.60 (57)	0.56 (16)	1.00 (2)	
42	EARLY	33		3.9	13.4			0.25	49	1.04	1.02	0.96	0.82	0.75	0.89	0.50	
	FINAL	37	5040	4.0	12.7	12.4	5095	0.21	47	1.20	0.97	0.74	0.71	0.60	0.79	0.17	12980
	LOCAL	41		4.0	13.0			0.20	46	0.87 (5135)	1.27 (4513)	0.97 (2372)	0.57 (776)	0.34 (159)	0.42 (19)	0.50 (6)	

Table 4.3. Contingency tables for early and final guidance and local surface wind speed forecasts for 94 stations, 0000 GMT cycle.

18-h Forecasts

EARLY

		1	2	3	4	5	6	7	T
	1	4161	1055	114	9	1	0	0	5340
	2	1943	2099	534	55	4	0	0	4635
	3	303	1062	842	165	17	3	0	2412
OBS	4	22	185	378	184	38	3	1	811
	5	3	15	56	61	32	4	1	172
	6	0	2	2	9	6	4	0	23
	7	0	1	1	2	4	2	0	10
	T	6432	4439	1927	485	102	16	2	13403

FINAL

		1	2	3	4	5	6	7	T
	1	4027	1139	150	13	1	0	0	5340
	2	1911	2093	566	60	5	0	0	4635
	3	311	1066	649	164	20	2	0	2412
OBS	4	30	197	369	179	35	1	0	811
	5	3	14	67	59	22	6	1	172
	6	0	0	3	7	9	4	0	23
	7	0	1	0	3	3	2	1	10
	T	6282	4510	2014	485	95	15	2	13403

LOCAL

		1	2	3	4	5	6	7	T
	1	2562	1920	329	27	2	0	0	5340
	2	1533	2534	965	102	9	2	0	4635
	3	159	937	1068	212	30	3	3	2412
OBS	4	19	123	394	231	40	3	1	811
	5	3	12	58	65	22	11	1	172
	6	0	1	5	10	5	1	1	23
	7	1	0	0	2	3	3	1	10
	T	4277	5497	2839	649	111	23	7	[illegible]3

30-h Forecasts

EARLY

		1	2	3	4	5	6	7	T
	1	6156	1314	148	5	0	0	0	7623
	2	1600	1553	419	35	3	0	0	3610
	3	269	626	418	67	7	0	0	1387
OBS	4	26	119	161	61	8	0	0	375
	5	2	8	26	15	6	0	0	57
	6	1	2	5	5	3	0	0	16
	7	0	1	0	1	0	0	0	2
	T	8054	3623	1177	189	27	0	0	13070

FINAL

		1	2	3	4	5	6	7	T
	1	6313	1138	154	18	0	0	0	7623
	2	1760	1385	411	53	1	0	0	3610
	3	306	617	368	86	10	0	0	1387
OBS	4	26	141	128	63	9	3	0	375
	5	3	17	21	9	6	1	0	57
	6	1	2	5	4	1	2	1	16
	7	0	0	1	0	1	0	0	2
	T	8409	3300	1088	238	28	6	1	13070

LOCAL

		1	2	3	4	5	6	7	T
	1	5260	2051	283	25	4	0	0	7623
	2	1325	1700	512	65	5	2	1	3610
	3	230	665	404	77	8	2	1	1387
OBS	4	35	112	147	68	10	3	0	375
	5	2	15	18	14	6	2	0	57
	6	1	2	4	8	1	0	0	16
	7	0	0	1	1	0	0	0	2
	T	6853	4545	1369	258	34	9	2	13070

42-h Forecasts

EARLY

		1	2	3	4	5	6	7	T
	1	3321	1432	327	48	5	1	1	5135
	2	1616	2027	743	110	15	2	0	4513
	3	342	914	829	236	44	7	0	2372
OBS	4	50	183	318	187	35	2	1	776
	5	5	30	55	48	17	3	1	159
	6	0	3	4	9	2	1	0	15
	7	1	0	2	1	1	1	0	6
	T	5335	4589	2278	639	119	17	3	12980

FINAL

		1	2	3	4	5	6	7	T
	1	3351	1310	242	26	4	2	0	5135
	2	2008	1825	555	117	8	0	0	4513
	3	528	984	614	207	37	2	0	2372
OBS	4	73	235	290	148	25	5	0	776
	5	12	34	48	45	14	4	1	159
	6	0	2	5	4	6	2	0	19
	7	0	1	1	2	2	0	0	6
	T	6172	4391	1755	550	96	15	1	12980

LOCAL

		1	2	3	4	5	6	7	T
	1	2765	1972	362	33	3	0	0	5135
	2	1262	2326	815	104	5	1	0	4513
	3	338	1094	756	157	22	3	2	2372
OBS	4	68	275	313	104	15	1	0	776
	5	9	50	52	38	7	3	0	159
	6	1	6	3	7	1	0	1	19
	7	0	1	2	2	1	0	0	6
		[illegible]43	5724	2303	445	54	8	3	12980

Table 4.4. Same as Table 4.2 except for 24 stations in the Eastern Region.

FCST PROJ (HOURS)	TYPE OF FCST	DIRECTION MEAN ABS ERROR (DEG)	DIRECTION NO. OF CASES	SPEED MEAN ABS ERROR (KTS)	SPEED MEAN FCST (KTS)	SPEED MEAN OBS (KTS)	SPEED NO. OF CASES	SKILL SCORE	PERCENT FCST CORRECT	CAT1 (NO. OBS)	CAT2 (NO. OBS)	CAT3 (NO. OBS)	CAT4 (NO. OBS)	CAT5 (NO. OBS)	CAT6 (NO. OBS)	CAT7 (NO. OBS)	NO. OF CASES
								CONTINGENCY TABLE		BIAS-NO. FCST/NO. OBS							
18	EARLY	25	1576	3.1	13.0	13.0	1582	0.31	53	1.19	0.96	0.84	0.78	0.91	0.40	*	3267
	FINAL	26		3.1	12.8			0.30	52	1.27	0.92	0.85	0.68	0.56	0.60	*	
	LOCAL	29		3.5	14.1			0.27	49	0.80 (1097)	1.07 (1243)	1.24 (658)	0.84 (219)	1.11 (45)	1.60 (5)	*** (0)	
30	EARLY	29	919	3.3	12.3	11.9	929	0.37	64	1.10	0.94	0.88	0.54	0.19	0.0	*	3222
	FINAL	31		3.7	12.5			0.32	61	1.11	0.90	0.82	0.71	0.56	3.00	*	
	LOCAL	35		4.0	13.6			0.30	57	0.88 (1803)	1.18 (894)	1.14 (392)	0.98 (114)	1.31 (16)	6.00 (1)	** (0)	
42	EARLY	31	1407	3.7	13.7	12.7	1420	0.26	49	1.16	0.92	0.94	0.88	0.83	1.00	*	3215
	FINAL	33		3.9	13.0			0.18	44	1.34	0.88	0.78	0.78	0.54	1.00	**	
	LOCAL	39		4.1	13.7			0.19	43	0.88 (1065)	1.10 (1222)	1.09 (657)	0.81 (226)	0.61 (41)	1.25 (4)	*** (0)	

* This category was neither forecast nor observed.
** This category was forecast once but was never observed.
*** This category was forecast twice but was never observed.

Table 4.5. Same as Table 4.2 except for 24 stations in the Southern Region.

FCST PROJ (HOURS)	TYPE OF FCST	DIRECTION: MEAN ABS ERROR (DEG)	DIRECTION: NO. OF CASES	SPEED: MEAN ABS ERROR (KTS)	SPEED: MEAN FCST (KTS)	SPEED: MEAN OBS (KTS)	SPEED: NO. OF CASES	CONTINGENCY TABLE: SKILL SCORE	CONTINGENCY TABLE: PERCENT FCST CORRECT	BIAS-NO. FCST/NO. OBS: CAT1 (NO. OBS)	CAT2 (NO. OBS)	CAT3 (NO. OBS)	CAT4 (NO. OBS)	CAT5 (NO. OBS)	CAT6 (NO. OBS)	CAT7 (NO. OBS)	NO. OF CASES
18	EARLY	25	1367	3.2	12.1	12.7	1376	0.27	52	1.32	0.88	0.76	0.46	0.50	0.57	0.0	3466
	FINAL	27		3.4	12.5			0.27	52	1.23	0.93	0.81	0.58	0.70	0.43	0.0	
	LOCAL	29		3.3	13.3			0.26	50	0.70 (1336)	1.29 (1313)	1.17 (580)	0.71 (199)	0.30 (30)	0.14 (7)	1.00 (1)	
30	EARLY	33	709	3.6	11.8	11.1	714	0.33	64	1.01	1.08	0.88	0.40	0.09	0.0	0.0	3361
	FINAL	36		3.7	11.6			0.33	66	1.12	0.88	0.69	0.50	0.36	0.0	0.0	
	LOCAL	39		3.7	11.8			0.27	60	0.91 (2086)	1.36 (882)	0.79 (310)	0.39 (70)	0.18 (11)	0.0 (1)	0.0 (1)	
42	EARLY	36	1299	3.9	13.0	12.0	1311	0.22	47	1.00	1.02	1.02	0.75	1.29	0.50	1.00	3286
	FINAL	42		3.8	12.1			0.19	47	1.22	1.00	0.72	0.48	0.63	0.0	0.0	
	LOCAL	46		3.8	12.2			0.16	45	0.80 (1252)	1.34 (1243)	0.97 (571)	0.30 (189)	0.04 (24)	0.0 (6)	0.0 (1)	

Table 4.6. Same as Table 4.2 except for 28 stations in the Central Region.

FCST PROJ (HOURS)	TYPE OF FCST	DIRECTION: MEAN ABS ERROR (DEG)	DIRECTION: NO. OF CASES	SPEED: MEAN ABS ERROR (KTS)	SPEED: MEAN FCST (KTS)	SPEED: MEAN OBS (KTS)	SPEED: NO. OF CASES	CONTINGENCY TABLE: SKILL SCORE	CONTINGENCY TABLE: PERCENT FCST CORRECT	BIAS-NO. FCST/NO. OBS: CAT1 (NO. OBS)	CAT2 (NO. OBS)	CAT3 (NO. OBS)	CAT4 (NO. OBS)	CAT5 (NO. OBS)	CAT6 (NO. OBS)	CAT7 (NO. OBS)	NO. OF CASES
	EARLY	21		3.2	12.7			0.31	52	1.21	1.03	0.86	0.58	0.52	0.50	0.14	
18	FINAL	23	2187	3.4	12.8	13.1	2209	0.28	49	1.10	1.09	0.91	0.58	0.55	0.60	0.14	4067
	LOCAL	26		3.4	13.8			0.24	47	0.63 (1229)	1.22 (1508)	1.22 (925)	0.85 (317)	0.62 (71)	0.70 (10)	0.29 (7)	
	EARLY	27		3.6	12.3			0.30	57	1.11	0.96	0.85	0.60	0.71	0.0	*	
30	FINAL	31	1249	3.8	12.2	11.7	1265	0.28	56	1.11	0.95	0.84	0.67	0.43	0.30	*	3991
	LOCAL	34		3.9	12.5			0.21	49	0.81 (1954)	1.33 (1318)	1.01 (538)	0.60 (150)	0.38 (21)	0.10 (10)	** (0)	
	EARLY	29		3.9	13.4			0.23	46	1.14	0.99	0.91	0.86	0.62	1.29	0.50	
42	FINAL	33	1911	4.1	13.0	12.8	1927	0.18	42	1.25	1.01	0.73	0.85	0.68	1.00	0.00	3967
	LOCAL	38		4.0	12.9			0.15	42	0.74 (1198)	1.36 (1498)	0.95 (907)	0.57 (291)	0.31 (71)	0.14 (7)	0.00 (4)	

* This category was neither forecast nor observed.
** This category was forecast once but was never observed.

Table 4.7. Same as Table 4.2 except for 18 stations in the Western Region.

FCST PROJ (HOURS)	TYPE OF FCST	DIRECTION: MEAN ABS ERROR (DEG)	DIRECTION: NO. OF CASES	SPEED: MEAN ABS ERROR (KTS)	SPEED: MEAN FCST (KTS)	SPEED: MEAN OBS (KTS)	SPEED: NO. OF CASES	CONTINGENCY TABLE: SKILL SCORE	CONTINGENCY TABLE: PERCENT FCST CORRECT	BIAS-NO. FCST/NO. OBS: CAT1 (NO. OBS)	CAT2 (NO. OBS)	CAT3 (NO. OBS)	CAT4 (NO. OBS)	CAT5 (NO. OBS)	CAT6 (NO. OBS)	CAT7 (NO. OBS)	NO. OF CASES
	EARLY	35		4.2	12.6			0.29	65	1.12	0.93	0.58	0.50	0.35	5.00	0.50	
18	FINAL	35	412	4.5	12.6	12.5	417	0.27	65	1.13	0.89	0.60	0.49	0.38	3.00	0.50	2603
	LOCAL	37		4.2	13.6			0.30	64	1.00 (1678)	1.10 (571)	0.88 (249)	0.72 (76)	0.31 (26)	7.00 (1)	1.00 (2)	
	EARLY	37		4.3	11.9			0.25	68	1.02	1.09	0.71	0.24	0.89	0.0	0.0	
30	FINAL	37	283	4.1	11.9	11.1	290	0.25	69	1.07	0.91	0.66	0.51	0.67	0.0	1.00	2498
	LOCAL	42		4.5	12.7			0.21	65	1.01 (1780)	1.04 (516)	0.94 (147)	0.71 (41)	0.33 (9)	0.50 (4)	0.0 (1)	
	EARLY	47		4.8	12.9			0.22	57	0.91	1.31	1.04	0.67	0.43	0.50	0.00	
42	FINAL	49	423	4.6	12.5	10.8	437	0.22	61	1.06	1.02	0.71	0.50	0.48	2.00	0.00	2503
	LOCAL	51		4.9	12.7			0.17	57	1.00 (1620)	1.21 (550)	0.73 (237)	0.57 (70)	0.26 (23)	1.00 (2)	1.00 (1)	

Table 4.8. Distribution of absolute errors associated with early and final guidance and local forecasts of surface wind direction for 94 stations, 0000 GMT cycle.

FORECAST PROJECTION (HOURS)	TYPE OF FORECAST	PERCENTAGE FREQUENCY OF ABSOLUTE ERRORS BY CATEGORY					
		0-30°	40-60°	70-90°	100-120°	130-150°	160-180°
18	EARLY	79.6	13.6	3.4	1.6	1.1	0.7
	FINAL	77.0	15.3	3.7	1.8	1.4	0.8
	LOCAL	73.7	17.1	4.3	2.1	1.8	1.0
30	EARLY	72.9	16.6	4.6	2.6	1.6	1.7
	FINAL	69.2	17.4	6.0	3.1	2.4	1.9
	LOCAL	65.2	18.9	7.6	3.8	2.4	2.1
42	EARLY	69.2	17.3	5.7	3.4	2.4	2.0
	FINAL	64.2	18.8	8.0	4.3	2.6	2.1
	LOCAL	57.3	22.6	9.3	4.7	3.5	2.6

Table 4.9. Same as Table 4.8 except for 24 stations in Eastern Region.

FORECAST PROJECTION (HOURS)	TYPE OF FORECAST	PERCENTAGE FREQUENCY OF ABSOLUTE ERRORS BY CATEGORY					
		0-30°	40-60°	70-90°	100-120°	130-150°	160-180°
18	EARLY	77.9	15.0	3.8	1.5	1.2	0.6
	FINAL	76.0	16.1	4.0	2.1	1.2	0.6
	LOCAL	72.1	18.9	4.9	2.0	1.5	0.6
30	EARLY	73.9	16.2	4.0	2.6	1.3	2.0
	FINAL	70.1	19.0	5.7	2.3	2.1	0.8
	LOCAL	67.8	17.3	7.3	3.8	2.1	1.7
42	EARLY	71.8	16.5	4.7	2.6	1.9	2.5
	FINAL	68.5	17.8	7.0	3.1	2.1	1.5
	LOCAL	61.2	20.8	9.2	4.1	2.6	2.1

Table 4.10. Same as Table 4.8 except for 24 stations in the Southern Region.

FORECAST PROJECTION (HOURS)	TYPE OF FORECAST	PERCENTAGE FREQUENCY OF ABSOLUTE ERRORS BY CATEGORY					
		0-30°	40-60°	70-90°	100-120°	130-150°	160-180°
18	EARLY	78.0	14.9	3.4	1.7	1.2	0.8
	FINAL	75.3	15.9	4.8	1.8	1.4	0.8
	LOCAL	73.4	17.3	4.2	2.4	1.8	0.9
30	EARLY	69.0	17.3	5.8	3.7	2.0	2.2
	FINAL	67.0	16.5	5.6	4.8	3.0	3.1
	LOCAL	62.1	19.7	7.8	4.1	3.4	2.9
42	EARLY	66.0	18.8	6.5	3.6	3.4	1.7
	FINAL	57.9	20.6	10.2	5.3	3.5	2.5
	LOCAL	50.1	26.7	10.4	5.8	3.8	3.2

Table 4.11. Same as Table 4.8 except for 28 stations in the Central Region.

FORECAST PROJECTION (HOURS)	TYPE OF FORECAST	PERCENTAGE FREQUENCY OF ABSOLUTE ERRORS BY CATEGORY					
		0-30°	40-60°	70-90°	100-120°	130-150°	160-180°
18	EARLY	84.2	11.3	2.3	1.1	0.7	0.4
	FINAL	80.6	13.8	2.6	1.3	1.0	0.7
	LOCAL	76.1	16.1	4.0	1.8	1.3	0.7
30	EARLY	76.0	16.3	3.8	1.7	1.2	1.0
	FINAL	70.0	17.8	6.0	2.5	2.2	1.5
	LOCAL	65.3	21.0	7.3	3.0	2.1	1.3
42	EARLY	72.8	16.3	5.0	3.2	1.5	1.2
	FINAL	68.1	17.8	6.8	3.7	1.9	1.7
	LOCAL	60.3	21.8	9.1	4.0	3.1	1.7

Table 4.12. Same as Table 4.8 except for 18 stations in the Western Region.

FORECAST PROJECTION (HOURS)	TYPE OF FORECAST	PERCENTAGE FREQUENCY OF ABSOLUTE ERRORS BY CATEGORY					
		0-30°	40-60°	70-90°	100-120°	130-150°	160-180°
18	EARLY	66.5	16.7	7.3	4.2	2.9	2.4
	FINAL	68.0	17.2	4.6	3.9	4.1	2.2
	LOCAL	68.9	15.3	3.6	3.2	5.1	3.9
30	EARLY	66.1	16.3	6.7	4.2	3.9	2.8
	FINAL	68.9	12.4	7.8	4.6	2.5	3.9
	LOCAL	64.0	13.4	9.2	6.4	2.5	4.5
42	EARLY	54.4	19.8	9.0	6.4	5.4	5.0
	FINAL	51.3	20.8	10.4	7.6	5.7	5.2
	LOCAL	53.2	18.9	7.8	6.4	7.1	6.6

Table 5.1 Definitions of the categories used for guidance forecasts of cloud amount.

Category	Cloud Amount (Opaque Sky Cover in tenths)
1	0-1
2	2-5
3	6-9
4	10

Table 5.2 Comparative verification of early and final guidance and local forecasts of four categories of cloud amount (clear, scattered, broken, overcast) for 94 stations, 0000 GMT cycle.

PROJECTION (HRS)	TYPE OF FORECAST	BIAS - NO. FCST/NO. OBS				PERCENT CORRECT	SKILL SCORE	NO. OF CASES
		CAT 1 (No. Obs.)	CAT 2 (No. Obs.)	CAT3 (No. Obs)	CAT4 (No. Obs.)			
18	EARLY	1.09	.83	.97	1.03	55.5	.385	12710
	FINAL	1.09	.82	.96	1.04	55.3	.381	
	LOCAL	.69 (3794)	1.46 (2380)	1.35 (2136)	.85 (4400)	52.2	.360	
30	EARLY	1.13	.82	.75	1.00	59.8	.383	12337
	FINAL	1.00	.77	.80	1.14	58.7	.383	
	LOCAL	.67 (4802)	1.98 (1613)	1.80 (1345)	.77 (4577)	49.5	.315	
42	EARLY	1.17	.82	.93	.99	49.6	.303	12339
	FINAL	.97	.74	1.11	1.12	49.7	.304	
	LOCAL	.57 (3678)	1.75 (2332)	1.52 (2048)	.71 (4281)	41.1	.225	

Table 5.3 Same as Table 5.2 except for 24 stations in the Eastern Region.

PROJECTION (HRS)	TYPE OF FORECAST	BIAS - NO. FCST/NO. OBS				PERCENT CORRECT	SKILL SCORE	NO. OF CASES
		CAT 1 (No. Obs.)	CAT 2 (No. Obs.)	CAT3 (No. Obs)	CAT4 (No. Obs.)			
18	EARLY	1.13	.76	.93	1.06	56.6	.387	3093
	FINAL	1.11	.77	.94	1.07	56.0	.379	
	LOCAL	.60 (728)	1.51 (571)	1.37 (543)	1.83 (1251)	53.1	.363	
30	EARLY	1.23	.48	1.06	.95	59.8	.389	3029
	FINAL	.94	.50	1.14	1.15	60.7	.395	
	LOCAL	.67 (1004)	1.91 (370)	1.89 (307)	.80 (1348)	51.8	.331	
42	EARLY	1.32	.73	.99	.95	50.0	.303	3012
	FINAL	.87	.66	1.25	1.12	50.1	.295	
	LOCAL	.51 (700)	1.69 (559)	1.44 (553)	.77 (1220)	45.2	.262	

Table 5.4 Same as Table 5.2 except for 24 stations in the Southern Region.

PROJECTION (HRS)	TYPE OF FORECAST	BIAS - NO. FCST/NO. OBS CAT 1 (No. Obs.)	CAT 2 (No. Obs.)	CAT3 (No. Obs)	CAT4 (No. Obs.)	PERCENT CORRECT	SKILL SCORE	NO. OF CASES
18	EARLY	1.08	.95	.91	1.00	57.6	.414	3275
	FINAL	1.09	.92	.91	1.00	56.2	.393	
	LOCAL	.77 (1102)	1.54 (626)	1.36 (527)	.73 (1020)	53.0	.374	
30	EARLY	1.13	1.10	.53	.93	60.2	.395	3230
	FINAL	1.08	.96	.57	1.04	60.3	.395	
	LOCAL	.79 (1427)	1.94 (421)	1.73 (335)	.68 (1047)	52.1	.338	
42	EARLY	1.20	.93	.72	.97	51.4	.323	3163
	FINAL	1.07	.79	.99	1.07	51.0	.322	
	LOCAL	.69 (1060)	1.86 (621)	1.53 (505)	.51 (977)	39.4	.205	

Table 5.5 Same as Table 5.2 except for 28 stations in the Central Region.

PROJECTION (HRS)	TYPE OF FORECAST	BIAS - NO. FCST/NO. OBS				PERCENT CORRECT	SKILL SCORE	NO. OF CASES
		CAT 1 (No. Obs.)	CAT 2 (No. Obs.)	CAT3 (No. Obs)	CAT4 (No. Obs.)			
18	EARLY	1.01	.75	1.10	1.07	59.3	.378	3893
	FINAL	1.03	.76	1.02	1.08	56.1	.388	
	LOCAL	.58 (1155)	1.53 (714)	1.33 (627)	.93 (1397)	51.0	.341	
30	EARLY	1.00	.75	.92	1.10	59.2	.387	3732
	FINAL	.86	.72	1.01	1.22	58.1	.371	
	LOCAL	.53 (1417)	2.21 (476)	1.92 (377)	.83 (1462)	47.1	.286	
42	EARLY	.94	.88	1.12	1.06	49.4	.298	3791
	FINAL	.81	.75	1.20	1.20	50.2	.305	
	LOCAL	.39 (1121)	1.81 (706)	1.62 (588)	.81 (1376)	40.2	.210	

Table 5.6 Same as Table 5.2 except for 18 stations in the Western Region.

PROJECTION (HRS)	TYPE OF FORECAST	BIAS - NO. FCST/NO. OBS				PERCENT CORRECT	SKILL SCORE	NO. OF CASES
		CAT 1 (No. Obs.)	CAT 2 (No. Obs.)	CAT3 (No. Obs)	CAT4 (No. Obs.)			
18	EARLY	1.16	.86	.90	.97	51.9	.337	2449
	FINAL	1.15	.83	.98	.96	52.1	.341	
	LOCAL	.80 (809)	1.20 (469)	1.36 (439)	.87 (732)	51.6	.352	
30	EARLY	1.21	.95	.49	.97	54.6	.330	2346
	FINAL	1.13	.91	.48	1.11	55.1	.340	
	LOCAL	.69 (954)	1.81 (346)	1.65 (326)	.73 (720)	46.7	.285	
42	EARLY	1.30	.69	.85	.94	47.1	.262	2373
	FINAL	1.15	.76	.92	1.03	46.7	.262	
	LOCAL	.72 (797)	1.57 (446)	1.45 (422)	.69 (708)	39.8	.204	

Table 6.1. Definitions of the categories used for guidance forecasts of ceiling and visibility.

Category	Ceiling (ft)	Visibility (mi)
1	< 200	< 1/2
2	200-400	1/2 - 7/8
3	500-900	1 - 2 1/2
4	1000-2900	3-4
5	3000-7500	5-6
6	> 7500	> 6

Table 6.2 Comparative verification of early and final guidance, persistance, and local ceiling forecasts for 94 stations, 0000 GMT cycle.

Projection (h)	Type of Forecast	Bias by Category						Percent Correct	Heidke Skill Score
		1	2	3	4	5	6		
12	Early	.71	.99	1.01	1.03	1.04	.99	62.7	.390
	Final	.75	.97	1.04	1.05	1.02	.99	66.1	.446
	Local	.55	.94	.85	1.17	1.07	.98	73.0	.560
	Persistence	.89	.89	.83	1.00	.99	1.03	75.6	.593
	No. Obs.	294	548	900	1943	1712	7705		
15	Local	.32	.58	.79	1.20	1.16	.99	66.4	.443
	Persistence	1.17	.81	.84	.97	1.02	1.03	66.4	.435
	No. Obs.	222	666	892	2017	1687	7949		
18	Early	.52	.98	1.00	1.07	1.05	.98	63.4	.375
	Final	.48	.89	1.03	1.08	1.06	.97	63.8	.383
	Persistence	2.73	1.17	.92	.91	1.08	.98	61.7	.347
	No. Obs.	102	481	833	2191	1651	8275		
21	Local	.18	.33	.70	1.21	1.25	.96	65.1	.376
	Persistence	4.34	1.44	1.10	1.02	.96	.95	59.3	.285
	No. Obs.	62	380	683	1917	1816	8587		
24	Early	.38	1.05	.84	1.12	.97	1.00	65.7	.374
	Final	.47	.97	.95	1.18	1.02	.97	64.6	.365
	Persistence	2.60	1.42	1.20	1.14	.90	.94	56.4	.239
	No. Obs.	107	397	640	1752	1980	8680		
36	Early	.35	.94	.79	1.11	1.04	1.02	57.4	.299
	Final	.69	1.16	.92	1.42	1.10	.88	54.4	.293
	Persistence	.94	.93	.82	.98	.99	1.04	48.5	.148
	No. Obs.	297	604	935	2035	1801	7866		
48	Early	.23	.95	.82	1.05	.94	1.03	61.8	.285
	Final	.24	.91	.87	1.19	1.15	.95	60.3	.291
	Persistence	2.93	1.44	1.19	1.15	.91	.94	47.9	.087
	No. Obs.	95	360	643	1738	1956	8713		

Table 6.3 Same as Table 6.2 except for visibility.

Projection (h)	Type of Forecast	Bias by Category 1	2	3	4	5	6	Percent Correct	Heidke Skill Score
12	Early	.91	1.27	.89	1.09	.83	1.01	69.4	.295
	Final	.74	1.10	1.01	1.12	.84	1.01	71.2	.339
	Local	.54	1.30	.76	1.34	1.31	.97	74.8	.449
	Persistence	.73	.89	.79	.82	1.01	1.05	78.6	.486
	No. Obs.	351	213	873	976	929	9334		
15	Local	.36	.61	.44	1.21	1.09	1.08	69.6	.317
	Persistence	.95	.65	.57	.89	.85	1.10	70.2	.317
	No. Obs.	279	284	1232	910	1103	9125		
18	Early	.70	.85	.82	1.15	.89	1.03	71.7	.276
	Final	.47	.84	.85	1.18	.80	1.03	72.7	.293
	Persistence	2.04	.78	.75	1.14	.92	1.01	70.6	.260
	No. Obs.	135	255	982	723	1061	10072		
21	Local	.17	.33	.44	1.32	1.13	1.03	76.0	.260
	Persistence	3.51	.91	.90	1.34	1.09	.96	71.1	.211
	No. Obs.	76	206	795	601	872	10414		
24	Early	.79	1.06	.80	1.17	.77	1.02	76.6	.267
	Final	.45	.99	.94	1.11	.91	1.01	76.3	.273
	Persistence	2.76	1.20	1.04	1.25	1.13	.95	70.6	.189
	No. Obs.	100	166	710	661	858	10734		
36	Early	.45	.75	.86	1.05	.86	1.05	66.6	.200
	Final	.80	.91	1.01	1.23	.97	.99	64.8	.213
	Persistence	.79	.88	.80	.81	.98	1.05	63.3	.121
	No. Obs.	349	226	924	1014	989	9726		
48	Early	.23	.89	1.06	.94	.64	1.04	76.0	.213
	Final	.24	.72	.99	1.08	.77	1.02	75.3	.208
	Persistence	2.76	1.21	1.05	1.29	1.14	.95	66.5	.071
	No. Obs.	100	165	700	641	854	10769		

Table 6.4 Same as Table 6.2 except for 1200 GMT cycle.

Projection (h)	Type of Forecast	Bias by Category 1	2	3	4	5	6	Percent Correct	Heidke Skill Score
12	Early	.62	.93	.96	1.06	.98	1.00	67.7	.405
	Final	.64	.94	.98	1.00	.99	1.01	70.1	.448
	Local	.30	.85	.91	1.26	.96	.98	76.5	.575
	Persistence	.68	.96	1.05	1.13	.94	.99	76.7	.576
	No. Obs.	98	373	612	1694	1952	8510		
15	Local	.23	.79	.96	1.26	.94	.99	70.6	.471
	Persistence	.56	.88	.98	1.11	.96	1.00	68.7	.433
	No. Obs.	124	413	653	1721	1905	8477		
18	Early	.76	.95	.99	1.01	1.04	1.01	63.6	.368
	Final	1.11	1.07	.91	.97	1.00	1.01	64.8	.385
	Persistence	.38	.76	.92	1.03	1.00	1.03	63.1	.347
	No. Obs.	190	491	736	1905	1894	8421		
21	Local	.21	.78	1.01	1.24	.95	.99	63.6	.385
	Persistence	.28	.69	.83	.98	1.03	1.06	59.1	.285
	No. Obs.	241	526	768	1925	1774	7945		
24	Early	.59	1.06	1.01	1.04	1.06	.98	59.4	.341
	Final	.66	1.23	.93	1.02	1.12	.97	60.0	.356
	Persistence	.24	.61	.71	.97	1.04	1.09	55.5	.240
	No. Obs.	304	609	949	2036	1813	7971		
36	Early	.34	1.17	.95	1.00	.93	1.02	63.2	.318
	Final	.33	1.17	1.07	1.12	1.13	.94	61.7	.322
	Persistence	.76	.90	1.04	1.13	.96	.99	52.4	.133
	No. Obs.	98	415	648	1747	1969	8803		
48	Early	.43	1.01	.92	.90	1.09	1.04	56.0	.271
	Final	.52	1.10	1.06	1.00	1.28	.94	54.3	.273
	Persistence	.24	.60	.71	.97	1.05	1.09	47.2	.098
	No. Obs.	304	627	944	2023	1810	7973		

Table 6.5 Same as Table 6.3 except for 1200 GMT cycle.

Projection (h)	Type of Forecast	Bias by Category 1	2	3	4	5	6	Percent Correct	Heidke Skill Score
12	Early	.38	.92	.87	.88	.84	1.04	78.5	.298
	Final	.39	.91	.89	.95	.87	1.03	79.9	.355
	Local	.45	1.06	.73	1.48	1.35	.96	81.3	.465
	Persistence	.86	1.30	1.13	.90	1.15	.98	83.3	.507
	No. Obs.	93	158	657	634	813	10305		
15	Local	.48	1.39	.87	1.69	1.32	.94	77.9	.367
	Persistence	.74	1.80	1.24	.91	1.20	.97	79.1	.370
	No. Obs.	105	110	607	634	787	10501		
18	Early	.79	1.15	.98	.91	.79	1.03	75.8	.269
	Final	.61	1.20	.98	.93	.93	1.02	75.8	.285
	Persistence	.47	1.43	1.18	.82	1.12	.99	75.3	.297
	No. Obs.	178	149	671	754	878	10607		
21	Local	.39	1.31	1.06	1.79	1.12	.93	70.5	.288
	Persistence	.32	1.15	1.06	.73	1.08	1.03	72.2	.235
	No. Obs.	244	173	705	775	866	9856		
24	Early	.78	1.22	1.12	.91	.93	1.01	67.1	.252
	Final	.85	1.07	1.13	.90	1.05	1.00	67.1	.261
	Persistence	.24	.91	.86	.61	.98	1.09	67.1	.177
	No. Obs.	353	236	932	1012	995	9756		
36	Early	.42	.91	1.14	.89	.74	1.02	75.6	.22[illegible]
	Final	.25	.95	1.24	1.07	.91	1.00	74.4	.228
	Persistence	.82	1.24	1.14	.95	1.14	.98	70.5	.136
	No. Obs.	102	174	701	651	857	10797		
48	Early	.48	.93	1.03	.93	.98	1.03	66.3	.205
	Final	.49	1.21	1.08	.99	1.04	1.00	65.2	.202
	Persistence	.24	.98	.85	.61	1.02	1.08	63.0	.071
	No. Obs.	355	219	935	1002	962	9807		

Table 6.6 Comparative verification of early and final guidance, persistance and local ceiling forecasts for 94 stations, 0000 GMT cycle. Scores are computed from two-category contingency tables.

Projection	Type of Forecast	Rel Freq Cats. 1&2 combined	Bias Cats. 1&2 combined	Percent Correct	Heidke Skill Score	Threat Score
12	Early	.068	.899	91.6	.300	.208
	Final		.900	93.1	.426	.301
	Local		.815	95.1	.580	.434
	Persistence		.892	95.4	.619	.474
15	Local	.066	.516	93.9	.364	.244
	Persistence		.902	93.4	.443	.314
18	Early	.043	.899	94.2	.266	.174
	Final		.820	94.7	.291	.189
	Persistence		1.44	92.7	.272	.183
21	Local	.033	.308	96.4	.157	.093
	Persistence		1.851	92.6	.178	.119
24	Early	.037	.908	94.9	.256	.165
	Final		.865	94.7	.215	.138
	Persistence		1.668	92.2	.173	.173
36	Early	.067	.746	91.1	.188	.132
	Final		1.002	90.0	.198	.144
	Persistence		.933	89.6	.133	.104
48	Early	.036	.806	94.9	.179	.115
	Final		.777	94.8	.164	.105
	Persistence		1.734	91.1	.050	.049

Table 6.7 Same as Table 6.6 except for visibility.

Projection	Type of Forecast	Rel Freq Cats. 1&2 combined	Bias Cats. 1&2 combined	Percent Correct	Heidke Skill Score	Threat Score
12	Early Final Local Persistence	.044	1.046 .874 .828 .791	93.3 94.6 96.1 96.4	.228 .330 .504 .536	.152 .218 .355 .384
15	Local Persistence	.044	.485 .801	95.6 94.6	.293 .284	.186 .185
18	Early Final Persistence	.029	.797 .709 1.217	95.6 96.0 94.6	.140 .178 .148	.089 .110 .095
21	Local Persistence	.022	.287 1.610	97.6 95.0	.118 .095	.068 .064
24	Early Final Persistence	.020	.959 .789 1.786	96.7 96.9 95.0	.137 .132 .087	.083 .079 .059
36	Early Final Persistence	.043	.567 .842 .826	93.9 93.3 93.1	.082 .132 .096	.059 .091 .070
48	Early Final Persistence	.020	.642 .540 1.792	97.0 97.1 94.7	.059 .050 .024	.038 .033 .025

Table 6.8 Same as Table 6.6 except for 1200 GMT cycle.

Projection	Type of Forecast	Rel Freq Cats. 1&2 combined	Bias Cats. 1&2 combined	Percent Correct	Heidke Skill Score	Threat Score
12	Early	.036	.864	95.4	.285	.182
	Final		.879	96.3	.432	.291
	Local		.738	97.2	.537	.380
	Persistence		.900	97.3	.589	.431
15	Local	.040	.663	96.3	.432	.290
	Persistence		.806	95.9	.416	.280
18	Early	.050	1.246	93.3	.260	.173
	Final		1.082	93.2	.305	.206
	Persistence		.653	94.3	.279	.182
21	Local	.058	.604	93.7	.289	.191
	Persistence		.558	93.2	.222	.146
24	Early	.067	.904	91.0	.244	.171
	Final		1.043	90.5	.255	.180
	Persistence		.431	91.7	.131	.092
36	Early	.038	1.014	94.3	.212	.138
	Final		1.007	94.2	.203	.132
	Persistence		.873	93.6	.063	.050
48	Early	.068	.823	90.3	.168	.123
	Final		.914	90.1	.186	.136
	Persistence		.481	90.8	.042	.044

Table 6.9 Same as Table 6.7 except for 1200 GMT cycle.

Projection	Type of Forecast	Rel Freq Cats. 1&2 combined	Bias Cats. 1&2 combined	Percent Correct	Heidke Skill Score	Threat Score
12	Early	.020	.721	97.2	.171	.102
	Final		.717	97.5	.266	.162
	Local		.833	97.9	.407	.264
	Persistence		1.139	98.0	.526	.366
15	Local	.017	.944	97.7	.280	.171
	Persistence		1.284	97.4	.305	.189
18	Early	.025	.954	96.1	.168	.104
	Final		.878	96.3	.193	.118
	Persistence		.905	96.3	.193	.118
21	Local	.033	.662	95.5	.208	.130
	Persistence		.767	95.3	.115	.074
24	Early	.044	.961	93.1	.175	.118
	Final		.937	93.1	.162	.110
	Persistence		.508	94.1	.092	.063
36	Early	.021	.728	96.8	.102	.062
	Final		.692	96.7	.057	.038
	Persistence		1.083	96.0	.049	.036
48	Early	.043	.652	93.7	.085	.062
	Final		.767	93.4	.096	.070
	Persistence		.521	93.7	.017	.023

Table 6.10 Heidke skill score for ceiling categories 1 and 2 combined for the comparative verification of early and final guidance, peristence, and local forecasts for 94 stations, 0000 GMT cycle.

Projection (h)	Type of Forecast	Year			
		1975/76	1976/77	1977/78	1978/79
12	Early		.317	.352	.300
	Final	.368	.226	.431	.426
	Local	.540	.452	.566	.580
	Persistence	.607	.529	.607	.619
	No. Cases	13915	4199	14030	13152
15	Local	.320		.363	.364
	Persistence	.242		.421	.443
	No. Cases	14984		14993	13433
18	Early		.190	.224	.266
	Final	.144	.246	.216	.291
	Persistence	.239	.123	.262	.272
	No. Cases	14009	4227	14202	13533
21	Local	.166	.053	.121	.157
	Persistence	.167	.086	.176	.178
	No. Cases	14979	4279	14983	13445
24	Early		.166	.182	.252
	Final	.043	.144	.188	.215
	Persistence	.131	.050	.149	.173
	No. Cases	14052	4224	14203	13536
36	Early			.215	.188
	Final		.187	.235	.198
	Persistence		.054	.127	.133
	No. Cases		4227	4971	13538
48	Early			.202	.179
	Final		.132	.195	.164
	Persistence		.036	.099	.050
	No. Cases		4224	4973	13535

Table 6.11 Same as Table 6.10 except for visibility.

Projection (h)	Type of Forecast	Year 1975/76	1976/77	1977/78	1978/79
12	Early		.221	.255	.228
	Final	.260	.217	.345	.330
	Local	.493	.462	.524	.504
	Persistence	.541	.494	.570	.536
	No. Cases	14142	4200	11810	12676
15	Local	.295	.194	.302	.293
	Persistence	.331	.193	.334	.284
	No. Cases	15322	4282	12633	12933
18	Early		.136	.218	.140
	Final	.120	.148	.207	.178
	Persistence	.194	.113	.215	.146
	No. Cases	14217	4226	11959	13228
21	Local	.117	.051	.166	.118
	Persistence	.107	.090	.114	.095
	No. Cases	15312	4274	12607	12964
24	Early		.138	.147	.137
	Final	.000	.127	.157	.132
	Persistence	.108	.056	.130	.087
	No. Cases	14230	4225	11959	13229
36	Early			.109	.082
	Final		.074	.158	.132
	Persistence		.045	.099	.096
	No. Cases		4226	4182	13228
48	Early			.142	.059
	Final		.048	.094	.050
	Persistence		.018	.051	.024
	No. Cases		4225	4182	13229

Table 6.12 Same as Table 6.10 except for the 1200 GMT cycle.

Projection (h)	Type of Forecast	Year 1975/76	1976/77	1977/78	1978/79
12	Early		.157	.277	.285
	Final	.301	.251	.351	.432
	Local	.472	.420	.487	.537
	Persistence	.520	.387	.576	.431
	No. Cases	13486	4217	14228	13238
15	Local	.387	.343	.390	.432
	Persistence	.344	.249	.423	.416
	No. Cases	14779	3232	14675	13293
18	Early		.215	.250	.260
	Final	.149	.272	.288	.305
	Persistence	.274	.215	.353	.279
	No. Cases	13632	4269	14454	13637
21	Local	.237	.270	.306	.289
	Persistence	.195	.143	.229	.222
	No. Cases	14786	4216	14672	13179
24	Early		.272	.232	.244
	Final	.100	.253	.298	.255
	Persistence	.126	.106	.176	.131
	No. Cases	13723	4269	14452	13682
36	Early			.212	.212
	Final		.064	.215	.203
	Persistence		−.002	.054	.063
	No. Cases		4266	5157	13680
48	Early			.204	.168
	Final		.153	.195	.186
	Persistence		.002	.070	.042
	No. Cases		4269	5755	13681

Table 6.13. Same as Table 6.11 except for the 1200 GMT cycle.

Projection (h)	Type of Forecast	Year 1975/76	1976/77	1977/78	1978/79
12	Early		.116	.205	.171
	Final	.087	.109	.266	.266
	Local	.452	.367	.457	.407
	Persistence	.441	.494	.442	.526
	No. Cases	13783	4237	12026	12660
15	Local	.340	.257	.323	.280
	Persistence	.263	.317	.309	.305
	No. Cases	15151	3234	12393	12744
18	Early		.094	.137	.168
	Final	.070	.131	.148	.193
	Persistence	.152	.121	.221	.193
	No. Cases	13895	4278	12212	13237
21	Local	.206	.169	.220	.208
	Persistence	.121	.089	.133	.115
	No. Cases	15127	4223	12393	12619
24	Early			.193	.175
	Final	.087		.200	.162
	Persistence	.071		.087	.092
	No. Cases	13897		12212	13281
36	Early			.139	.102
	Final		.074	.093	.057
	Persistence		.022	.054	.049
	No. Cases		4277	4345	13282
48	Early			.152	.085
	Final		.024	.129	.096
	Persistence		.011	.032	.017
	No. Cases		4278	4345	13280

Table 6.14. Bias for ceiling categories 1 and 2 combined for the comparative verification of early and final guidance, persistence, and local forecasts for 94 stations, 0000 GMT cycle.

Projection (h)	Type of Forecast	Year 1975/76	1976/77	1977/78	1978/79
12	Early		.79	.89	.90
	Final	.59	.37	.84	.90
	Local	.76	.67	.88	.82
	Persistence	.82	.81	.81	.89
15	Local	.54		.55	.52
	Persistence	.95		.96	.90
18	Early		1.26	.85	.90
	Final	.20	1.00	.78	.82
	Persistence	1.66	1.73	1.52	1.44
21	Local	.35	.17	.38	.31
	Persistence	2.27	2.22	1.88	1.85
24	Early		1.00	.75	.91
	Final	.10	.73	.75	.87
	Persistence	2.09	1.99	1.72	1.67
36	Early			.59	.75
	Final		.89	.72	1.00
	Persistence		.80	.97	.93
48	Early			.66	.81
	Final		1.16	.71	.78
	Persistence		1.77	2.06	1.73

Table 6.15. Same as Table 6.14 except for visibility.

Projection (h)	Type of Forecast	Year 1975/76	1976/77	1977/78	1978/79
12	Early		.88	.83	1.05
	Final	.47	.75	.81	.87
	Local	.79	.76	.82	.83
	Persistence	.79	.69	.81	.79
15	Local	.51	.38	.49	.49
	Persistence	.90	.66	.76	.80
18	Early		1.20	.77	.80
	Final	.14	.85	.68	.71
	Persistence	1.60	1.08	1.24	1.22
21	Local	.28	.37	.32	.29
	Persistence	2.00	1.29	1.66	1.61
24	Early		1.35	.83	.96
	Final	.00	1.26	.69	.79
	Persistence	2.18	1.29	1.91	1.79
36	Early			.49	.57
	Final		.45	.74	.84
	Persistence		.70	.90	.83
48	Early			.83	.64
	Final		1.21	.58	.54
	Persistence		1.14	1.87	1.79

Table 6.16. Same as Table 6.14 except for the 1200 GMT cycle.

Projection (h)	Type of Forecast	Year			
		1975/76	1976/77	1977/78	1978/79
12	Early		1.00	.77	.86
	Final	.66	.91	.83	.88
	Local	.69	.67	.90	.74
	Persistence	.91	.94	.73	.90
15	Local	.62	.59	.68	.66
	Persistence	.73	.74	.78	.81
18	Early		1.24	.86	1.25
	Final	.28	1.06	1.04	1.08
	Persistence	.60	.63	.65	.65
21	Local	.50	.54	.60	.60
	Persistence	.45	.51	.52	.56
24	Early		.77	.86	.90
	Final	.17	.84	.96	1.04
	Persistence	.36	.39	.46	.43
36	Early			1.06	1.01
	Final		1.57	.72	1.01
	Persistence		.89	.92	.87
48	Early			.58	.82
	Final		.92	.60	.91
	Persistence		.39	.47	.48

Table 6.17. Same as Table 6.15 except for the 1200 GMT cycle.

Projection (h)	Type of Forecast	Year			
		1975/76	1976/77	1977/78	1978/79
12	Early		.53	.70	.72
	Final	.24	.60	.64	.71
	Local	.70	.72	1.16	.83
	Persistence	1.09	1.04	.84	1.14
15	Local	.77	.74	.80	.94
	Persistence	1.08	1.21	1.06	1.28
18	Early		1.22	.65	.95
	Final	.15	.94	.72	.88
	Persistence	.72	1.08	.82	.91
21	Local	.56	.55	.67	.66
	Persistence	.51	.82	.62	.77
24	Early			.83	.96
	Final	.10		.86	.94
	Persistence	.38		.49	.51
36	Early			.66	.73
	Final		1.00	.49	.69
	Persistence		.95	1.07	1.08
48	Early			.65	.65
	Final		.93	.56	.77
	Persistence		.59	.59	.52

Table 7.1. Comparative verification of early and final guidance and local max/min temperature forecasts for 87 stations, 0000 GMT cycle.

FORECAST PROJECTION (HOURS)	TYPE OF FORECAST	MEAN ALGEBRAIC ERROR (°F)	MEAN ABSOLUTE ERROR (°F)	NUMBER (%) OF ABSOLUTE ERRORS ≥ 10°	NUMBER OF CASES
24 (MAX)	EARLY	0.0	3.5	636 (4.3)	14770
	FINAL	-0.3	3.7	778 (5.3)	
	LOCAL	-0.4	3.4	595 (4.0)	
36 (MIN)	EARLY	0.4	4.5	1442 (9.7)	14811
	FINAL	0.4	4.6	1560 (10.5)	
	LOCAL	1.2	4.5	1534 (10.4)	
48 (MAX)	EARLY	0.0	4.6	1611 (10.9)	14765
	FINAL	-0.2	5.0	1917 (13.0)	
	LOCAL	-0.5	4.5	1525 (10.3)	
60 (MIN)	EARLY	0.5	5.5	2495 (16.8)	14886
	FINAL	0.6	5.4	2368 (15.9)	
	LOCAL	1.0	5.4	2429 (16.3)	

Table 7.2. Same as Table 7.1 except for 26 stations in the Eastern Region.

FORECAST PROJECTION (HOURS)	TYPE OF FORECAST	MEAN ALGEBRAIC ERROR (^{o}F)	MEAN ABSOLUTE ERROR (^{o}F)	NUMBER (%) OF ABSOLUTE ERRORS $\geq 10^{o}$	NUMBER OF CASES
24 (MAX)	EARLY	-0.3	3.6	194 (4.4)	4437
	FINAL	-0.9	3.7	221 (5.0)	
	LOCAL	-0.9	3.5	180 (4.1)	
36 (MIN)	EARLY	0.1	4.5	381 (8.6)	4436
	FINAL	0.5	4.5	434 (9.8)	
	LOCAL	1.4	4.6	469 (10.6)	
48 (MAX)	EARLY	-0.9	4.5	451 (10.2)	4436
	FINAL	-0.7	4.8	546 (12.3)	
	LOCAL	-1.2	4.6	437 (9.9)	
60 (MIN)	EARLY	-0.2	5.5	754 (16.9)	4469
	FINAL	1.2	5.6	736 (16.5)	
	LOCAL	1.5	5.5	743 (16.6)	

Table 7.3. Same as Table 7.1 except for 23 stations in the Southern Region.

FORECAST PROJECTION (HOURS)	TYPE OF FORECAST	MEAN ALGEBRAIC ERROR (°F)	MEAN ABSOLUTE ERROR (°F)	NUMBER (%) OF ABSOLUTE ERRORS ≥ 10°	NUMBER OF CASES
24 (MAX)	EARLY	0.2	3.5	176 (4.5)	3894
	FINAL	-0.3	3.8	221 (5.7)	
	LOCAL	-0.2	3.4	159 (4.1)	
36 (MIN)	EARLY	0.2	4.3	333 (8.5)	3902
	FINAL	0.1	4.4	343 (8.8)	
	LOCAL	0.7	4.3	335 (8.6)	
48 (MAX)	EARLY	-0.3	4.7	452 (11.6)	3900
	FINAL	-0.2	5.2	562 (14.4)	
	LOCAL	-0.3	4.5	444 (11.4)	
60 (MIN)	EARLY	-0.1	5.1	592 (15.1)	3921
	FINAL	0.0	5.1	555 (14.2)	
	LOCAL	0.4	5.3	593 (15.1)	

Table 7.4. Same as Table 7.1 except for 22 stations in the Central Region.

FORECAST PROJECTION (HOURS)	TYPE OF FORECAST	MEAN ALGEBRAIC ERROR ($^{\circ}$F)	MEAN ABSOLUTE ERROR ($^{\circ}$F)	NUMBER (%) OF ABSOLUTE ERRORS $\geq 10^{\circ}$	NUMBER OF CASES
24 (MAX)	EARLY	-0.1	3.7	175 (4.7)	3726
	FINAL	0.0	4.1	243 (6.5)	
	LOCAL	-0.4	3.6	183 (4.9)	
36 (MIN)	EARLY	0.6	5.0	493 (13.1)	3753
	FINAL	0.3	5.2	540 (14.4)	
	LOCAL	1.3	4.9	488 (13.0)	
48 (MAX)	EARLY	0.7	5.0	493 (13.2)	3722
	FINAL	-0.3	5.5	585 (15.7)	
	LOCAL	-0.6	4.9	436 (11.7)	
60 (MIN)	EARLY	0.9	6.2	796 (21.1)	3765
	FINAL	0.5	6.0	717 (19.0)	
	LOCAL	1.1	5.9	732 (19.4)	

Table 7.5. Same as Table 7.1 except for 16 stations in the Western Region.

FORECAST PROJECTION (HOURS)	TYPE OF FORECAST	MEAN ALGEBRAIC ERROR (°F)	MEAN ABSOLUTE ERROR (°F)	NUMBER (%) OF ABSOLUTE ERRORS ≥ 10°	NUMBER OF CASES
24 (MAX)	EARLY	0.3	3.2	91 (3.4)	2713
	FINAL	0.2	3.1	93 (3.4)	
	LOCAL	0.3	2.9	73 (2.7)	
36 (MIN)	EARLY	1.0	4.0	235 (8.6)	2720
	FINAL	0.6	4.2	243 (8.9)	
	LOCAL	1.0	4.2	242 (8.9)	
48 (MAX)	EARLY	1.0	4.2	215 (7.9)	2707
	FINAL	0.6	4.2	224 (8.3)	
	LOCAL	0.3	4.0	208 (7.7)	
60 (MIN)	EARLY	1.9	5.1	353 (12.9)	2731
	FINAL	0.7	4.9	360 (13.2)	
	LOCAL	1.1	4.9	361 (13.2)	

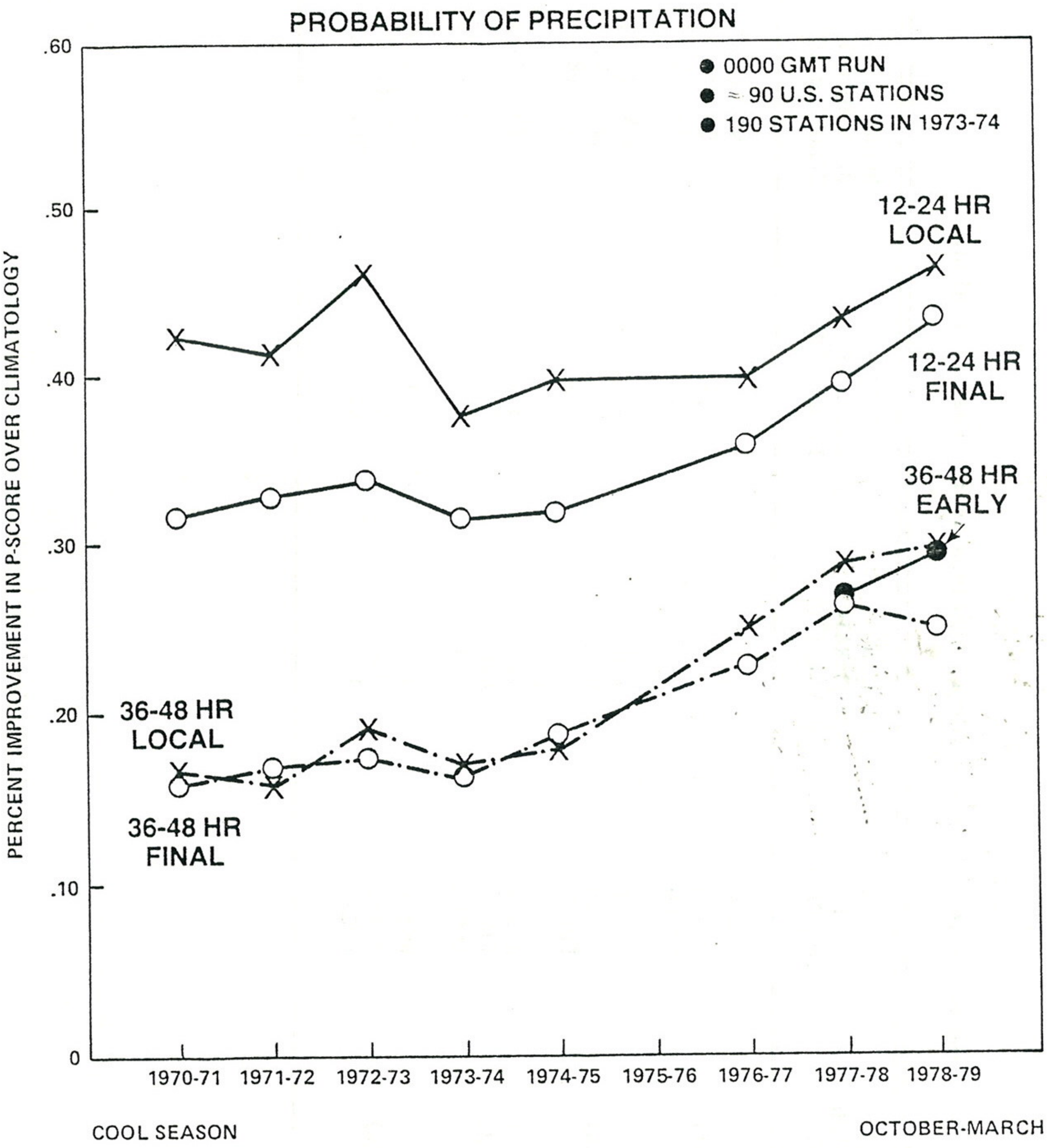

Figure 2.1 Percent improvement in Brier score over climatology of local and final guidance PoP forecasts.

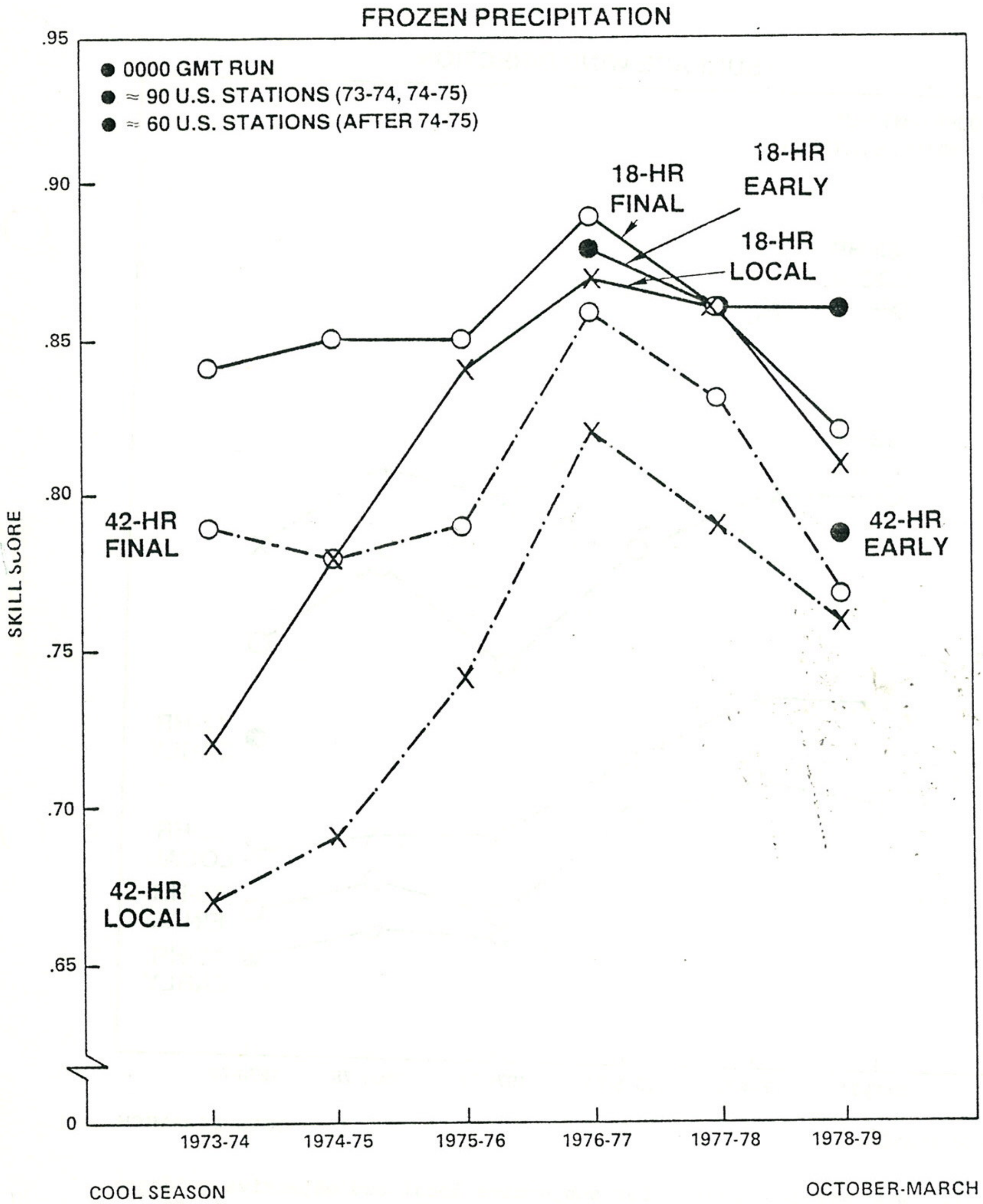

Figure 3.1. The skill scores for guidance and local forecasts of frozen precipitation.

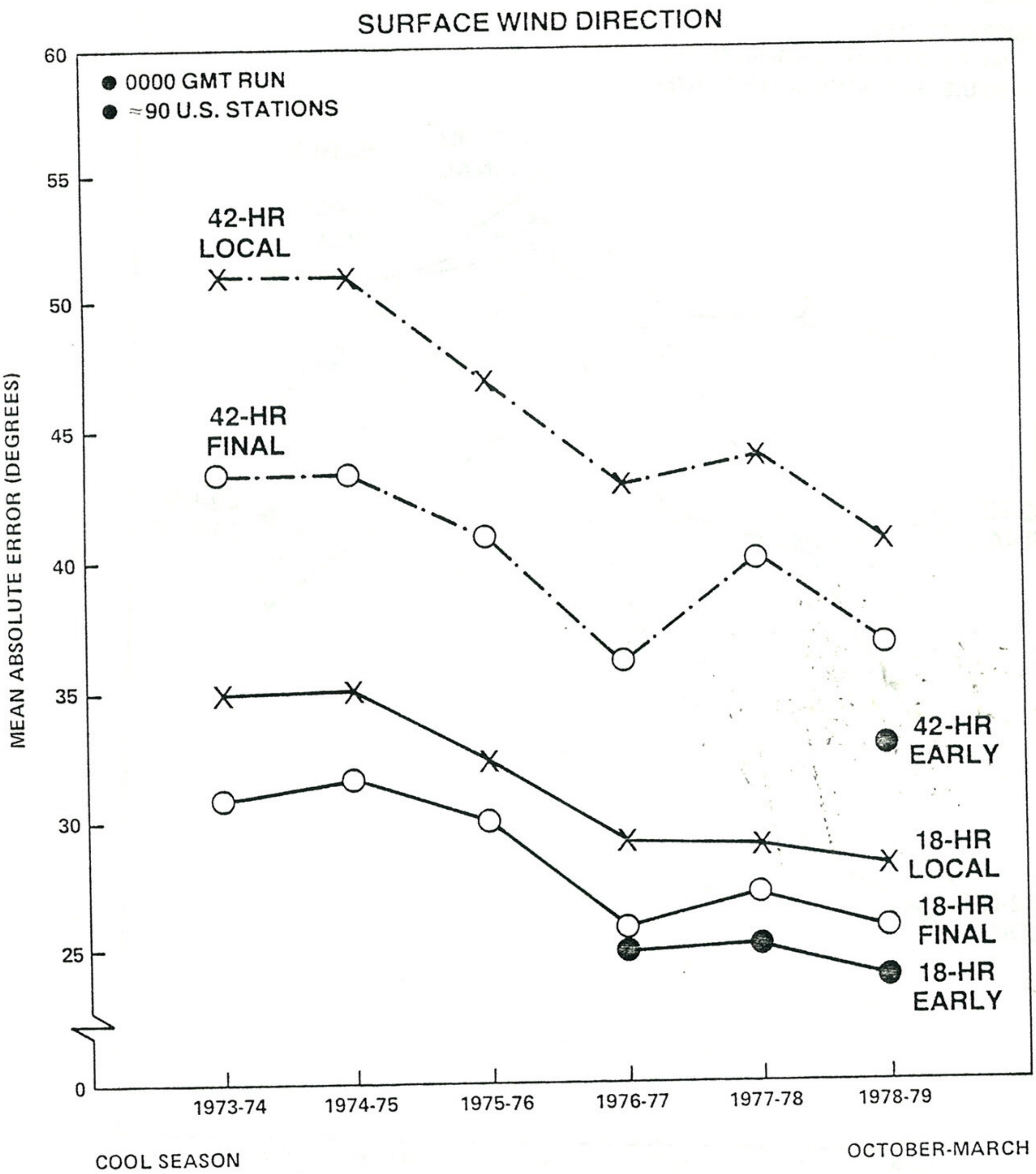

Figure 4.1. Mean absolute errors for subjective local and objective guidance (early and final) surface wind direction forecasts for approximately 90 U.S. stations.

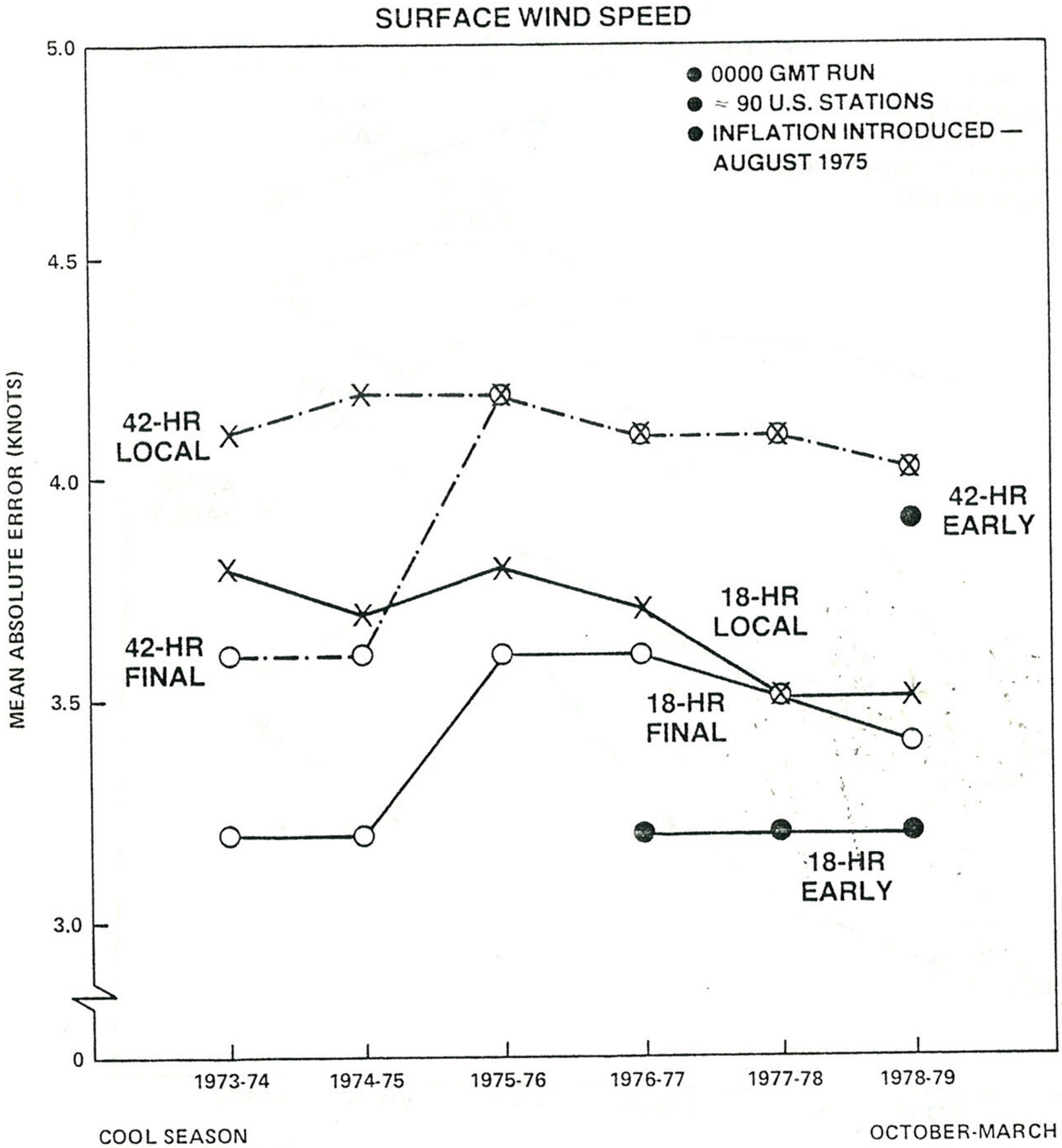

Figure 4.2. Same as Fig. 4.1 except for wind speed forecasts.

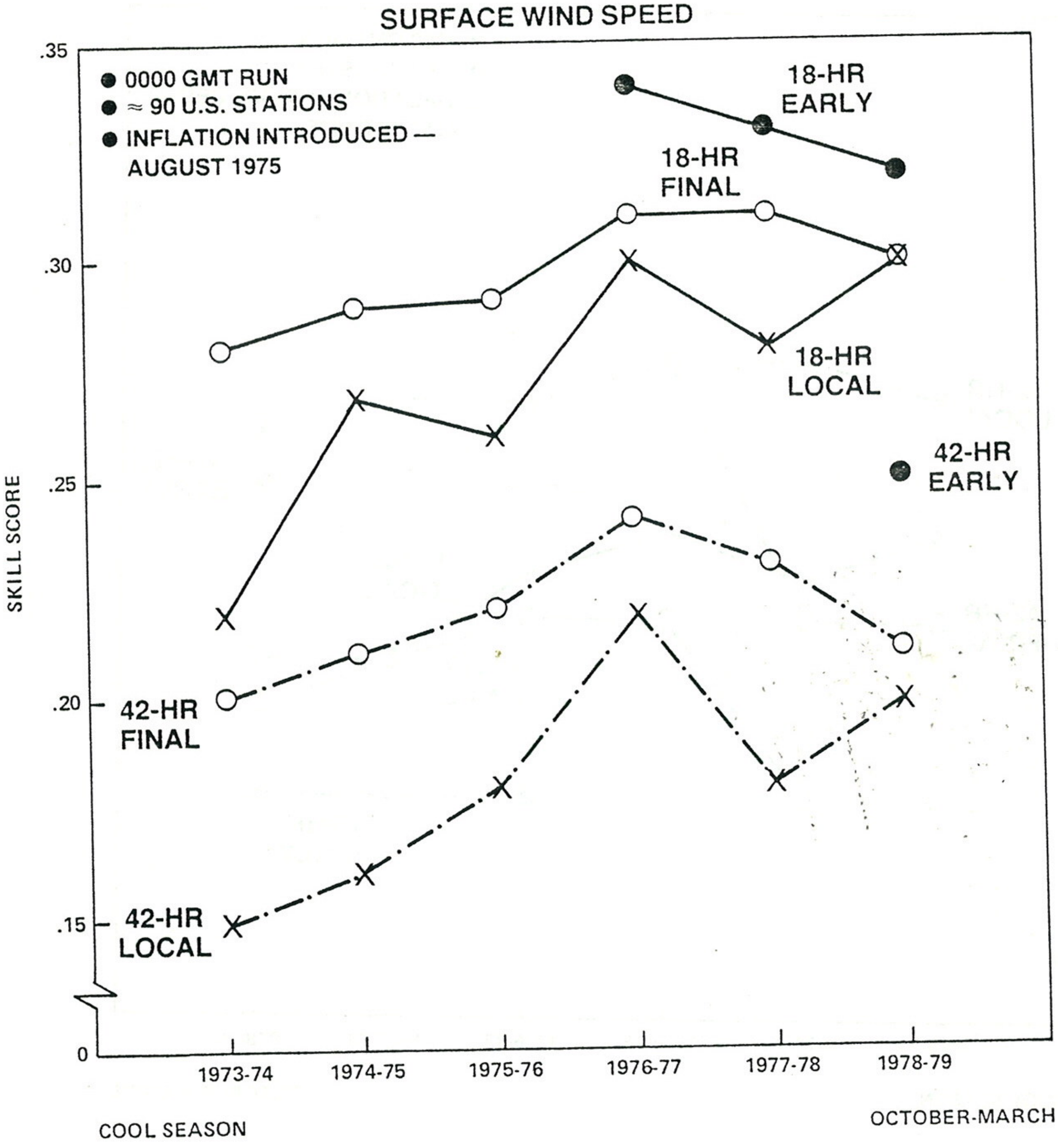

Figure 4.3. Skill scores computed from five category contingency tables for subjective local and objective guidance (early and final) surface wind speed forecasts for approximately 90 U.S. stations.

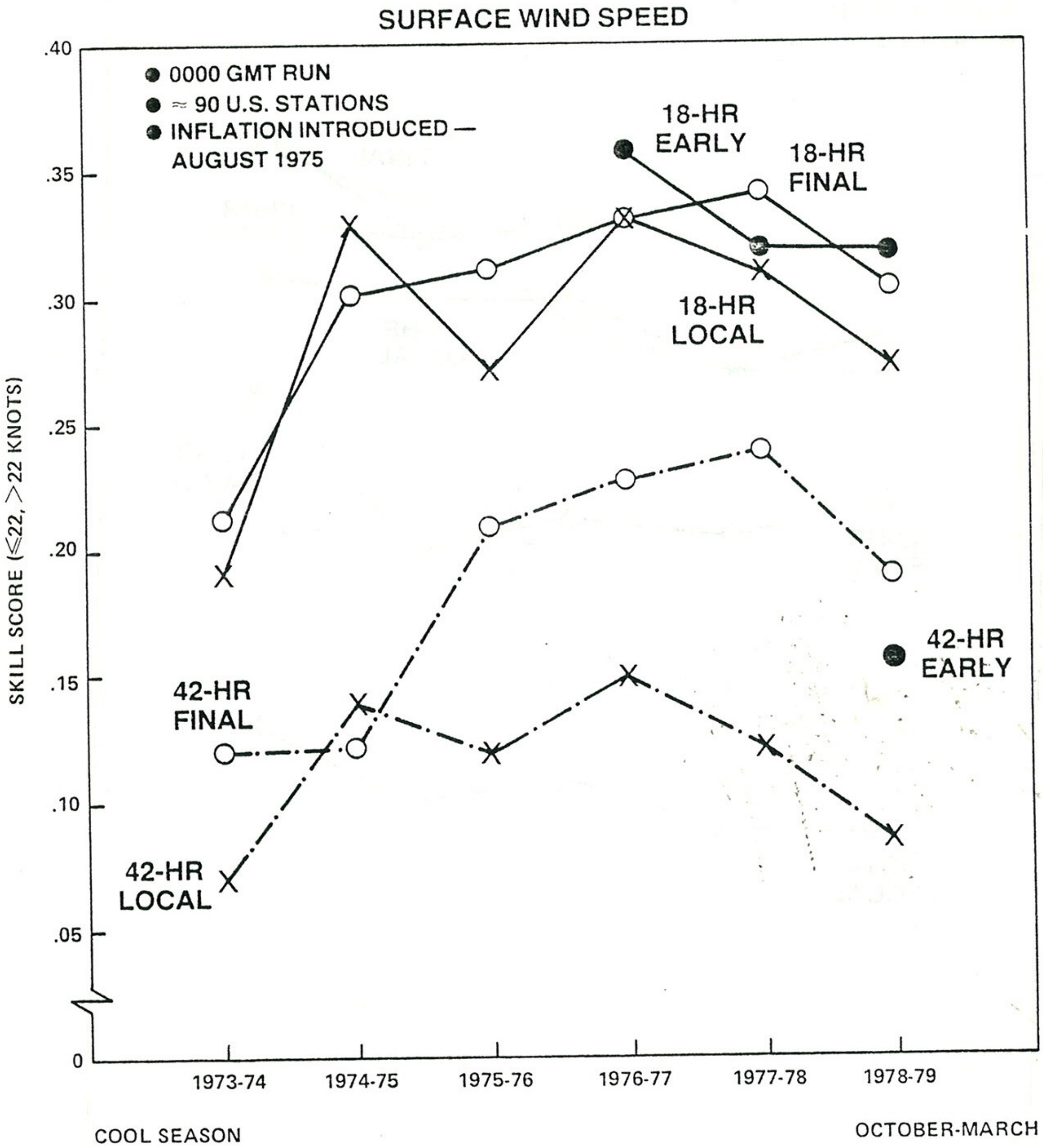

Figure 4.4. Same as Fig. 4.3 except for two-category contingency tables.

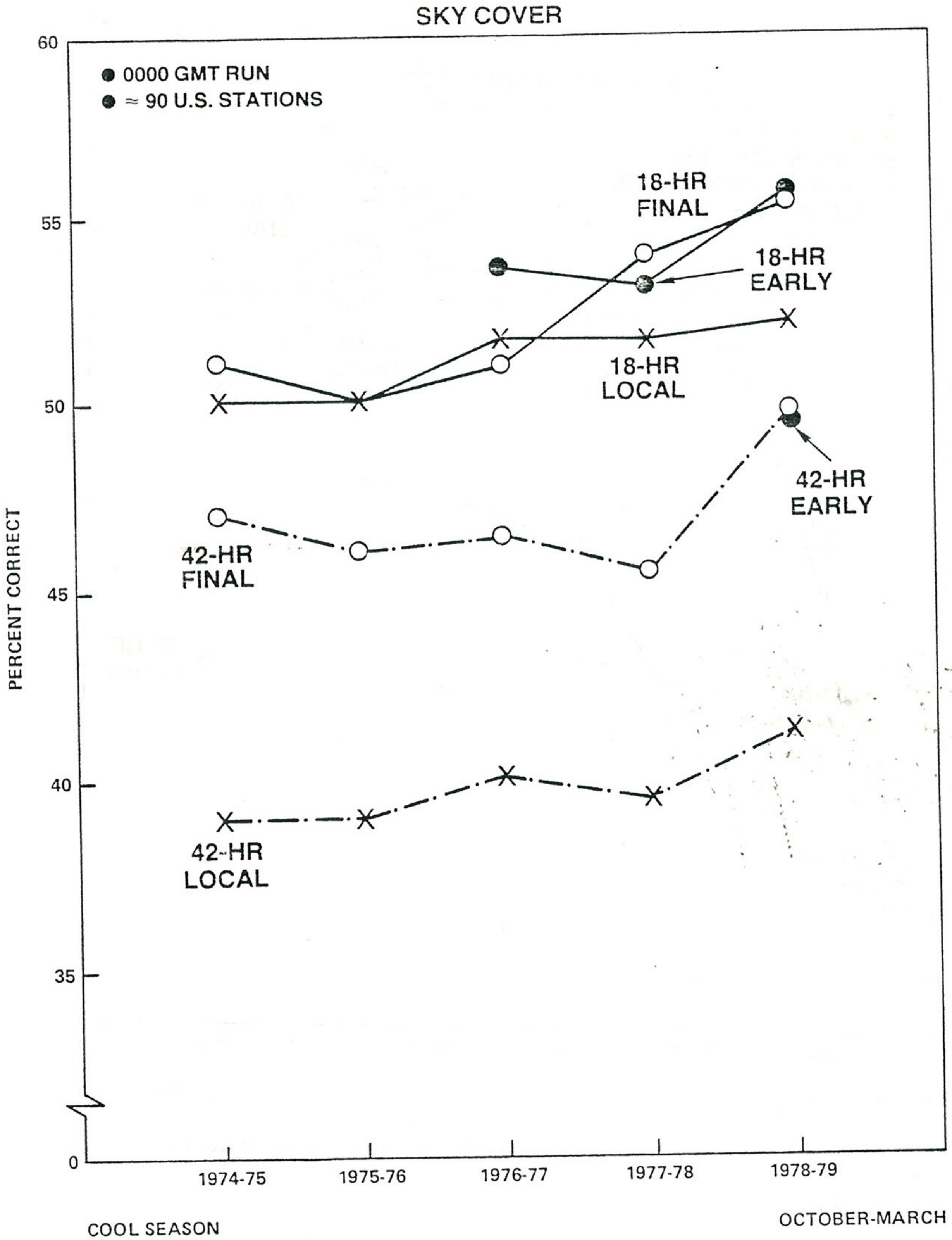

Figure 5.1. Percent correct for local and guidance cloud amount forecasts.

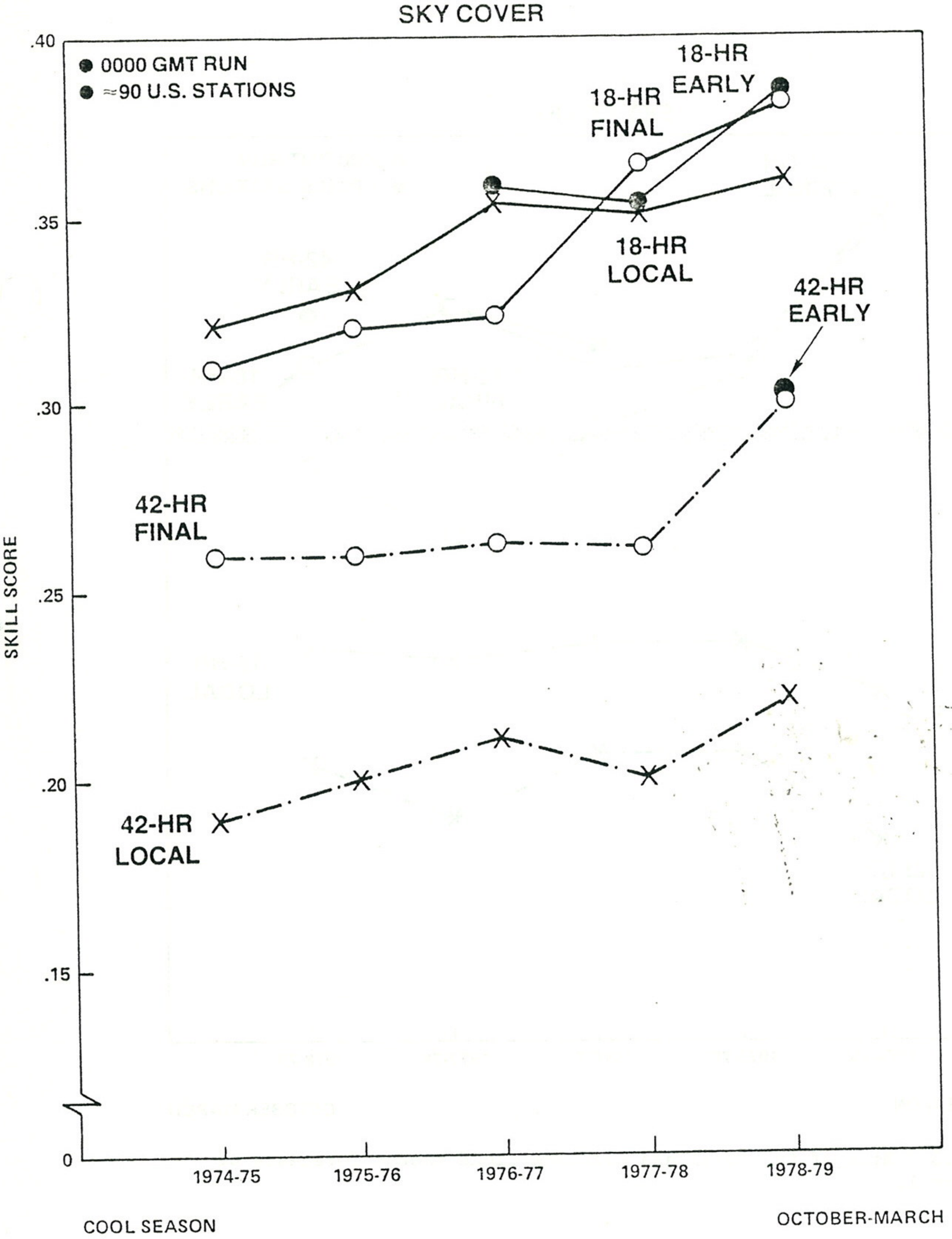

Figure 5.2. Skill score for local and guidance cloud amount forecasts.

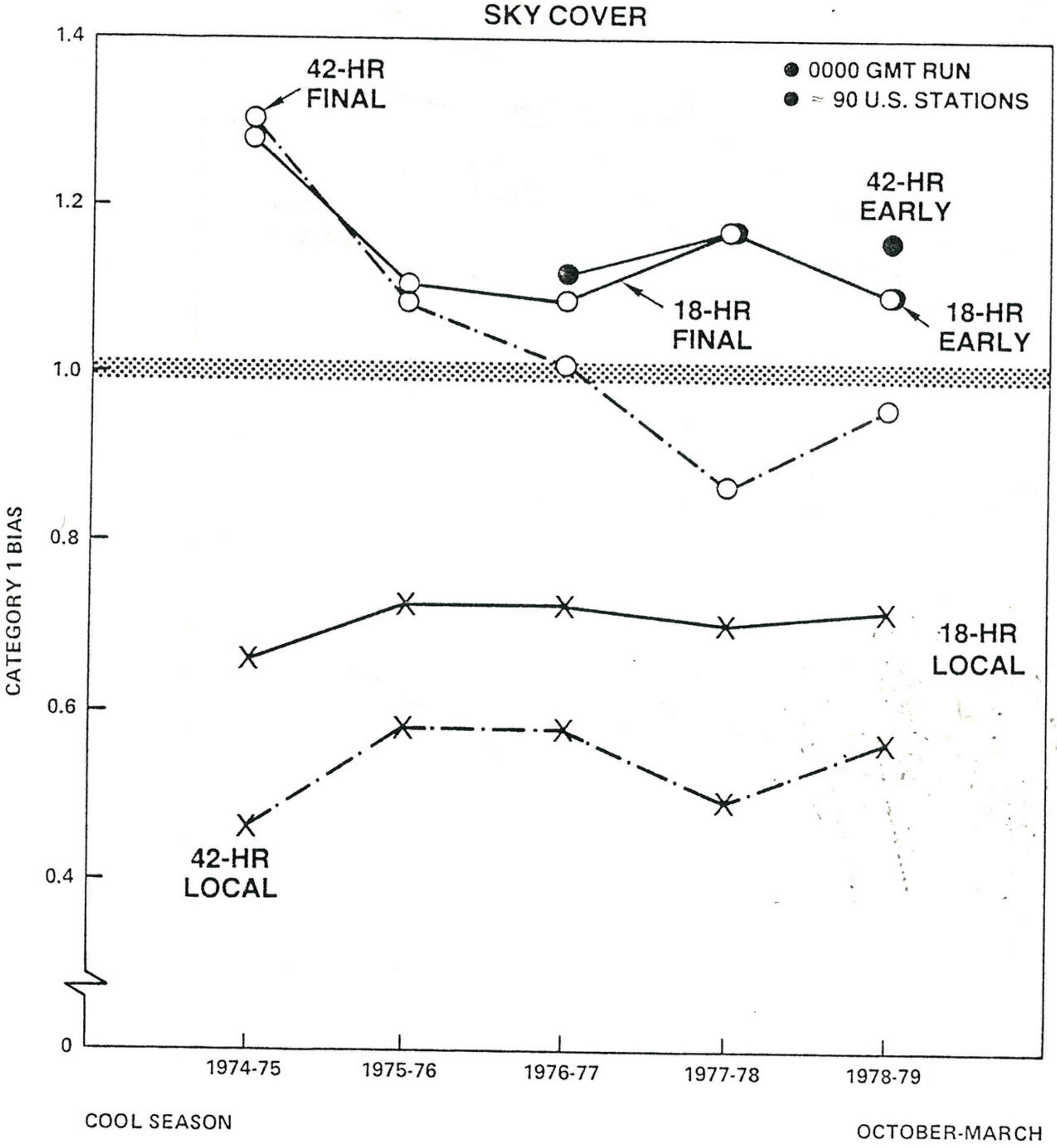

Figure 5.3. Bias of the local and guidance cloud amount forecasts of category 1.

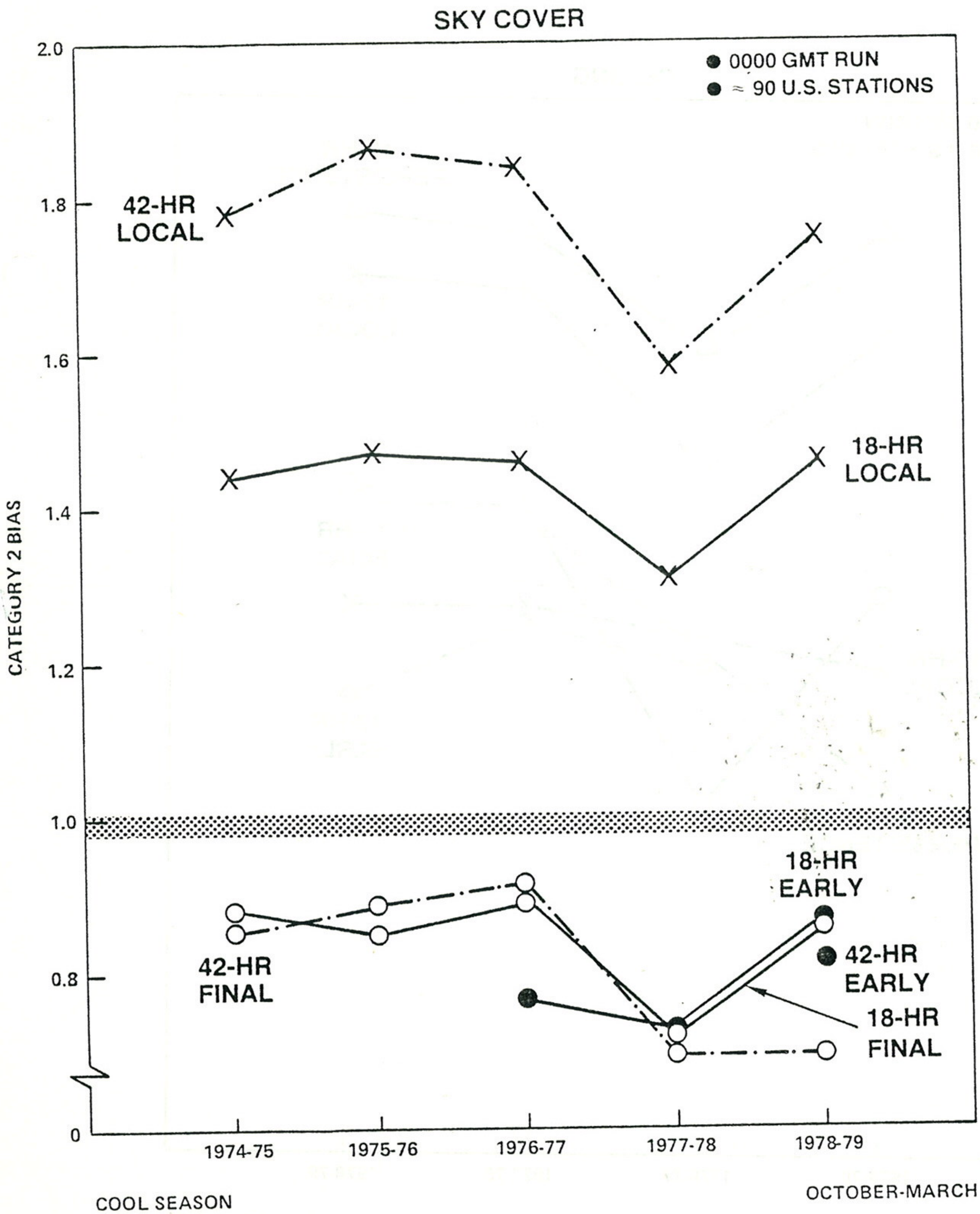

Figure 5.4. Same as Fig. 5.3 except for category 2 bias.

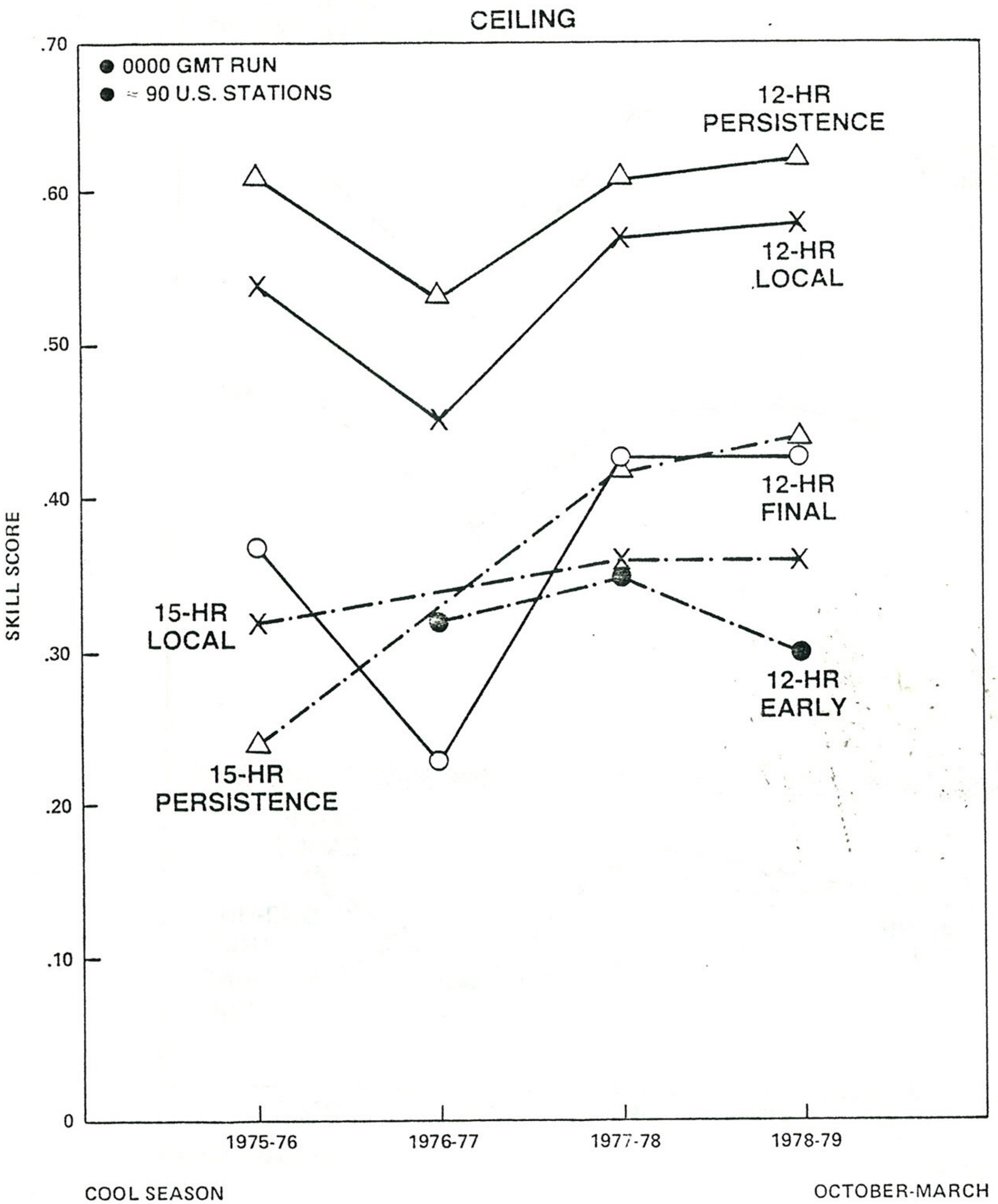

Figure 6.1. Skill score computed from two-category contingency tables for guidance, locals, and persistence ceiling forecasts for 94 stations, 0000 GMT cycle.

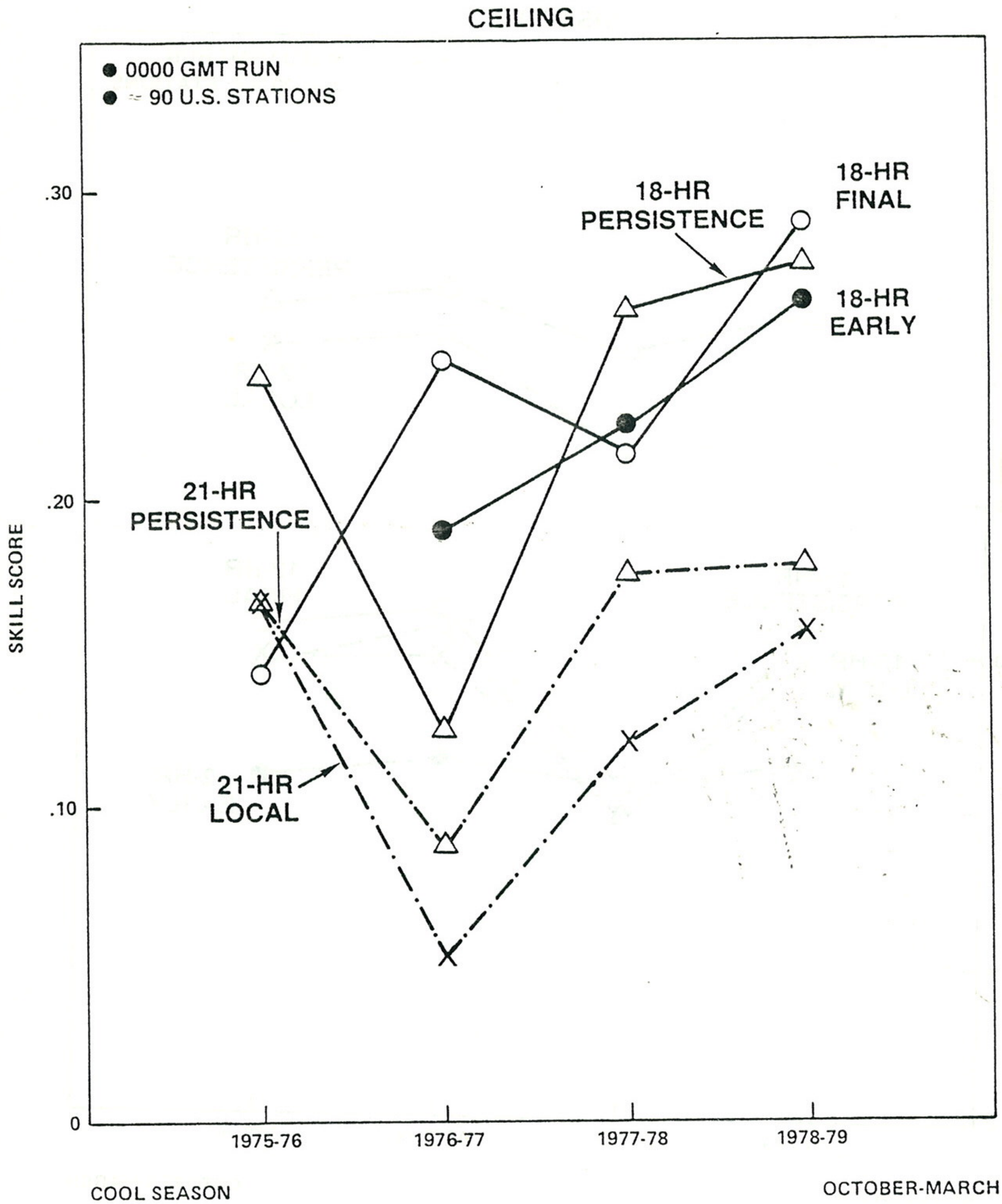

Figure 6.2. Same as Fig. 6.1.

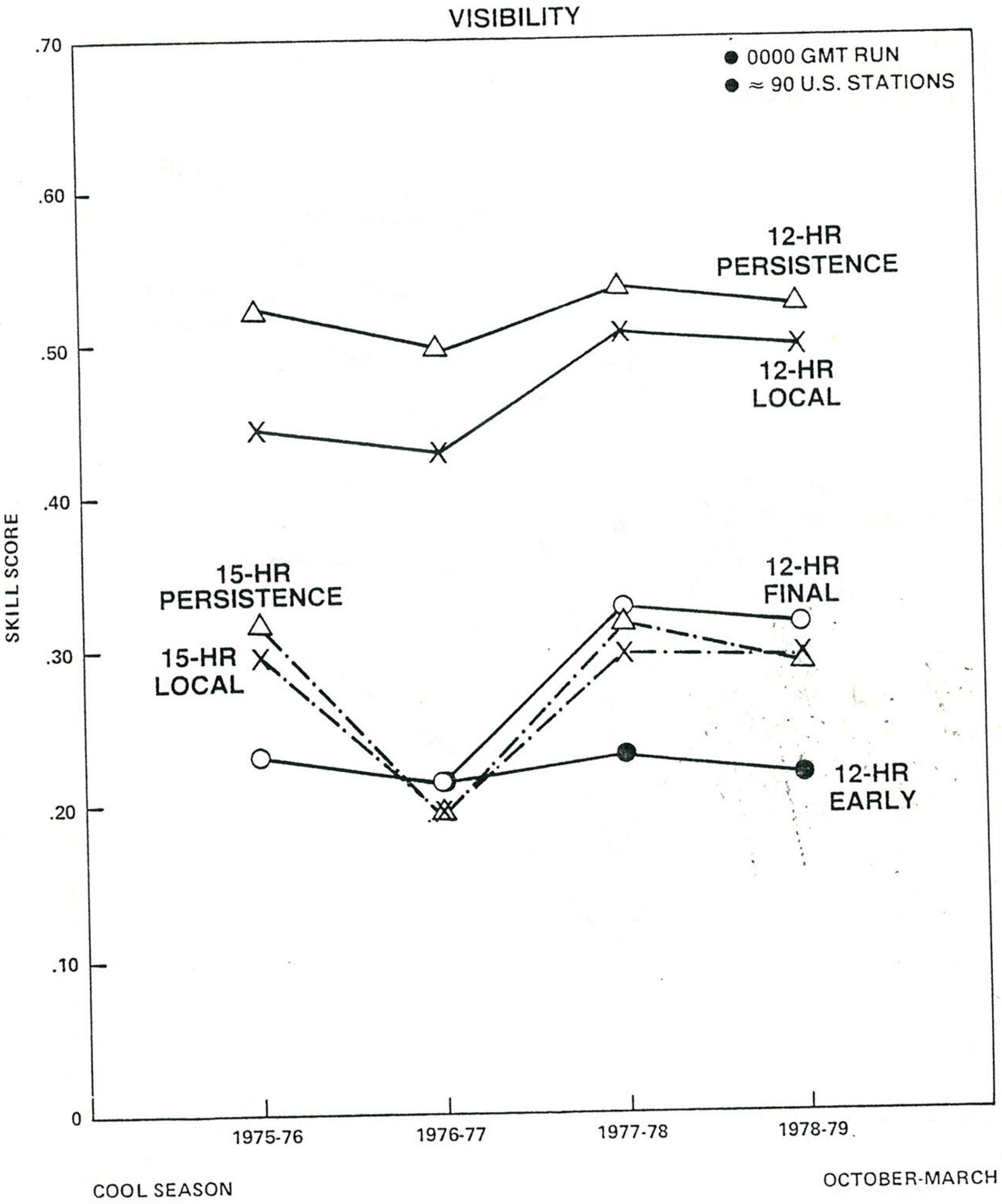

Figure 6.3 Same as Fig. 6.1 except for visibility forecasts.

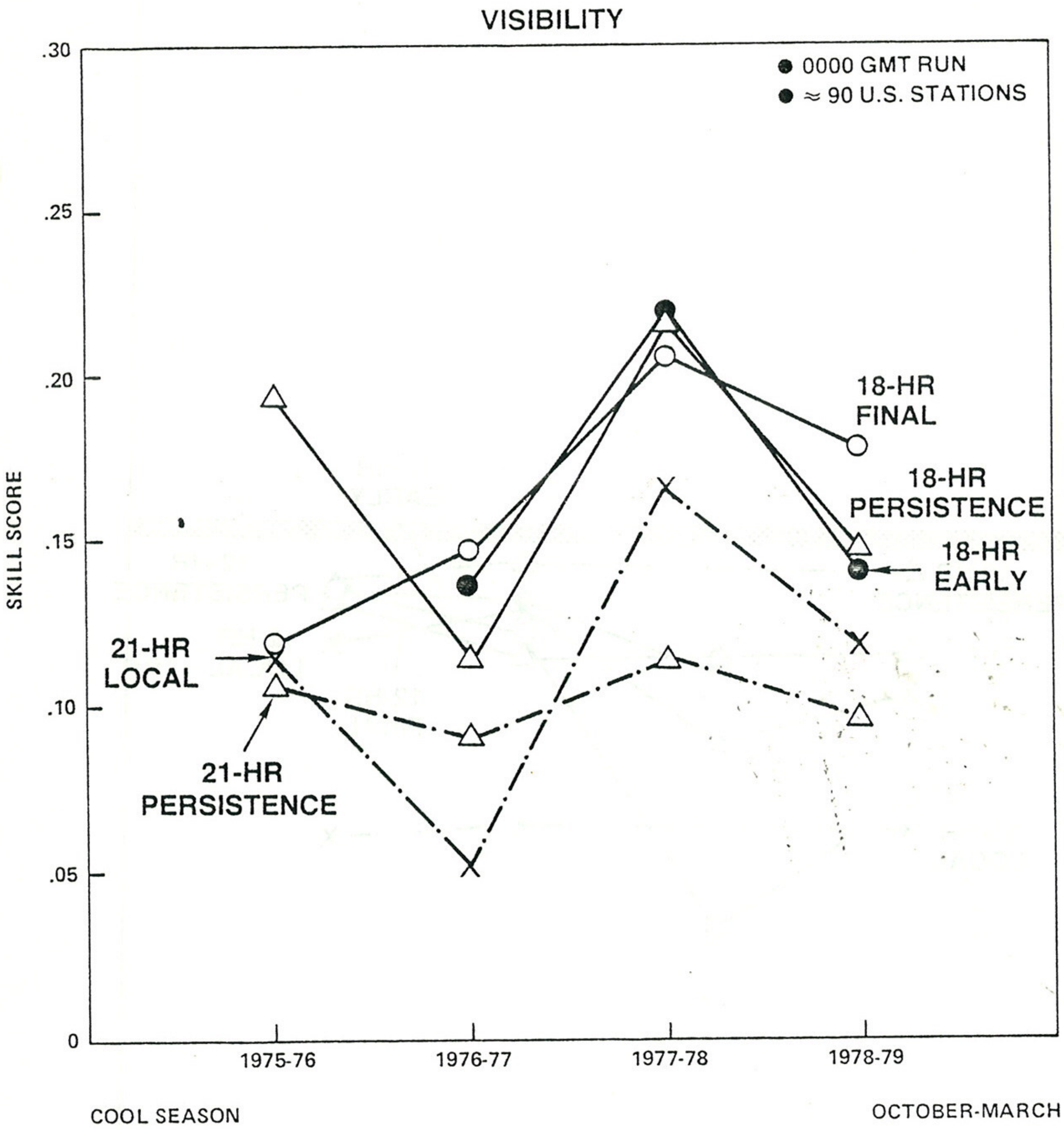

Figure 6.4. Same as Fig. 6.3.

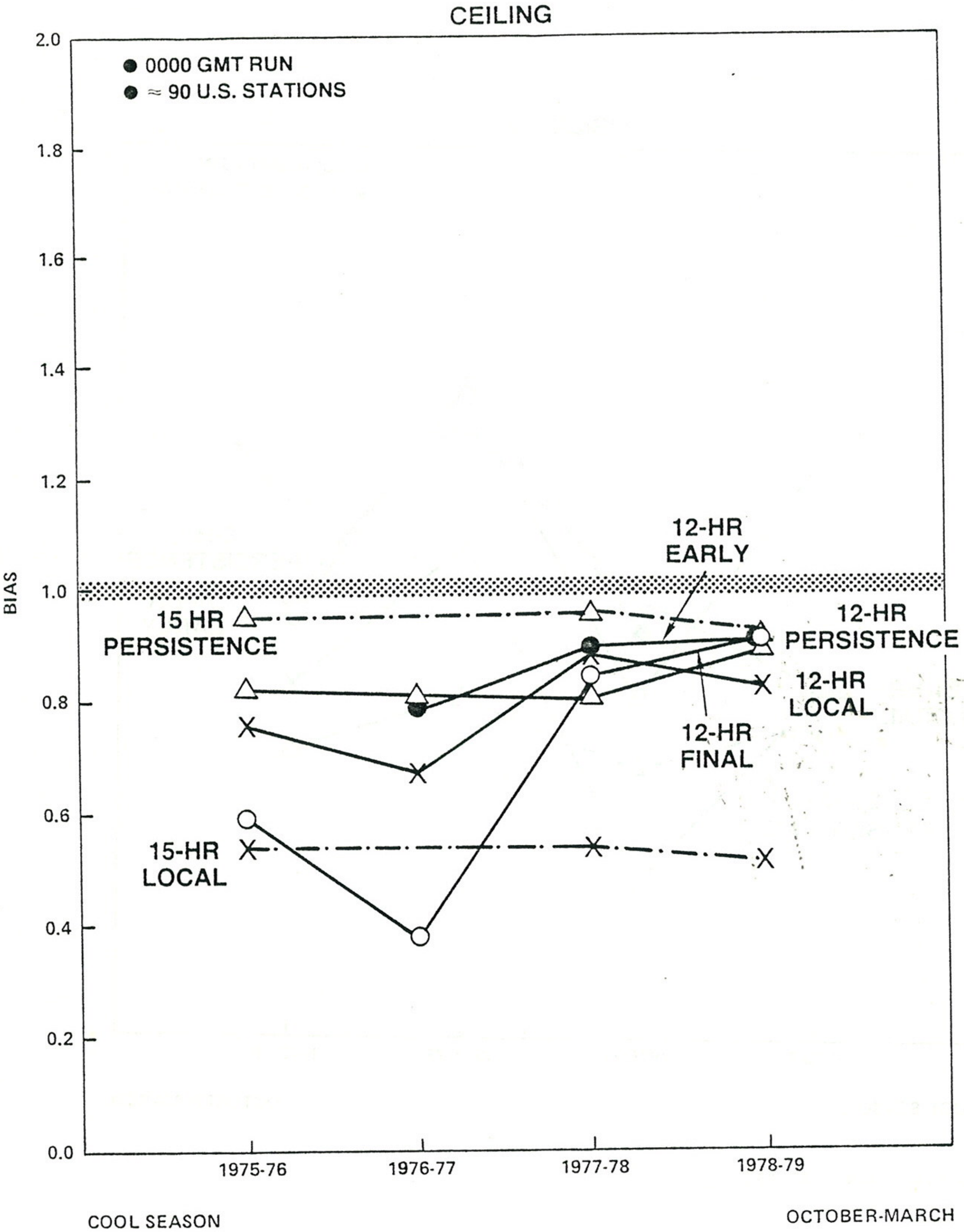

Figure 6.5. Bias for categories 1 and 2 combined for guidance, local, and persistence ceiling forecasts for 94 stations, 0000 GMT cycle.

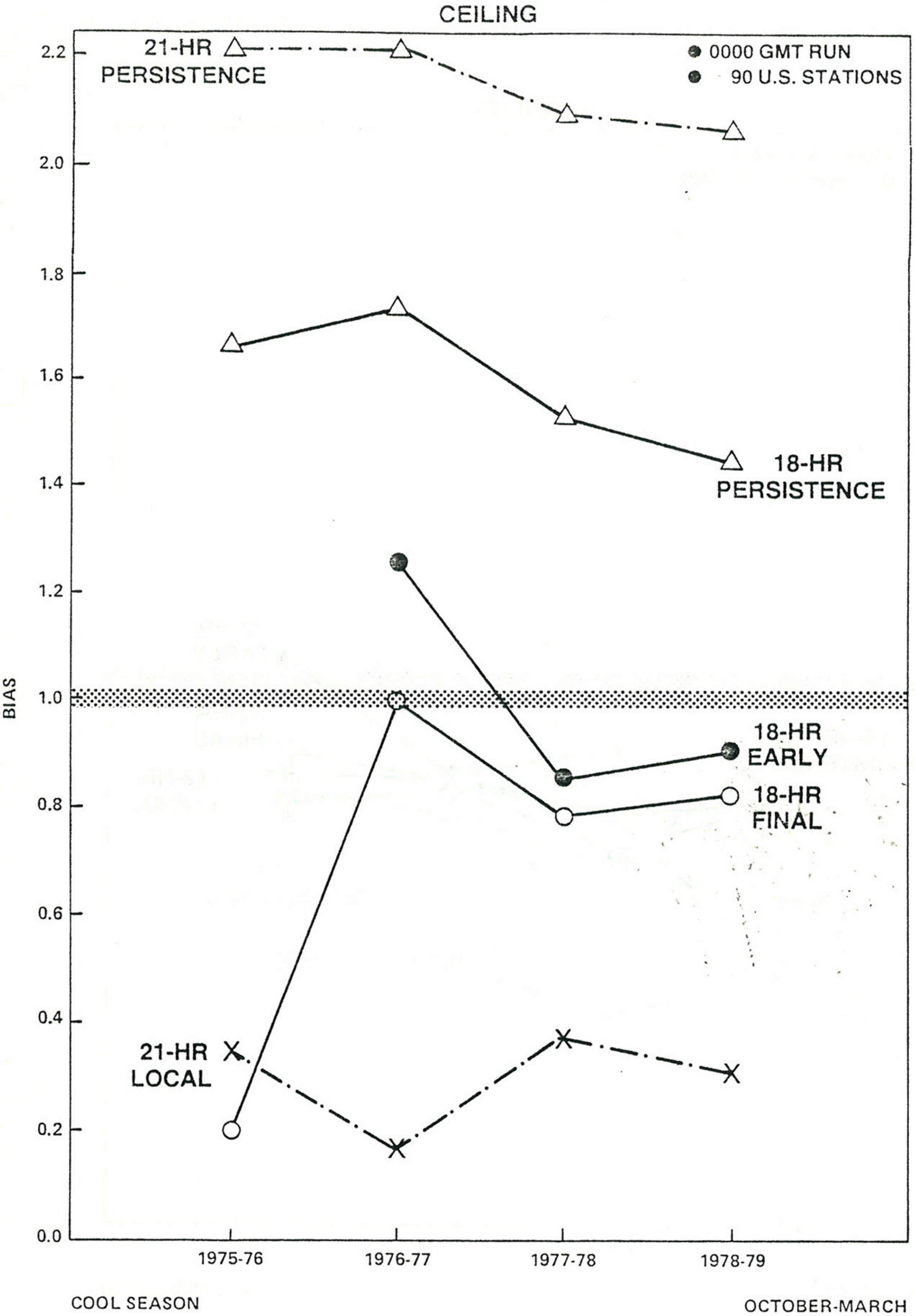

Figure 6.6. Same as Fig. 6.5.

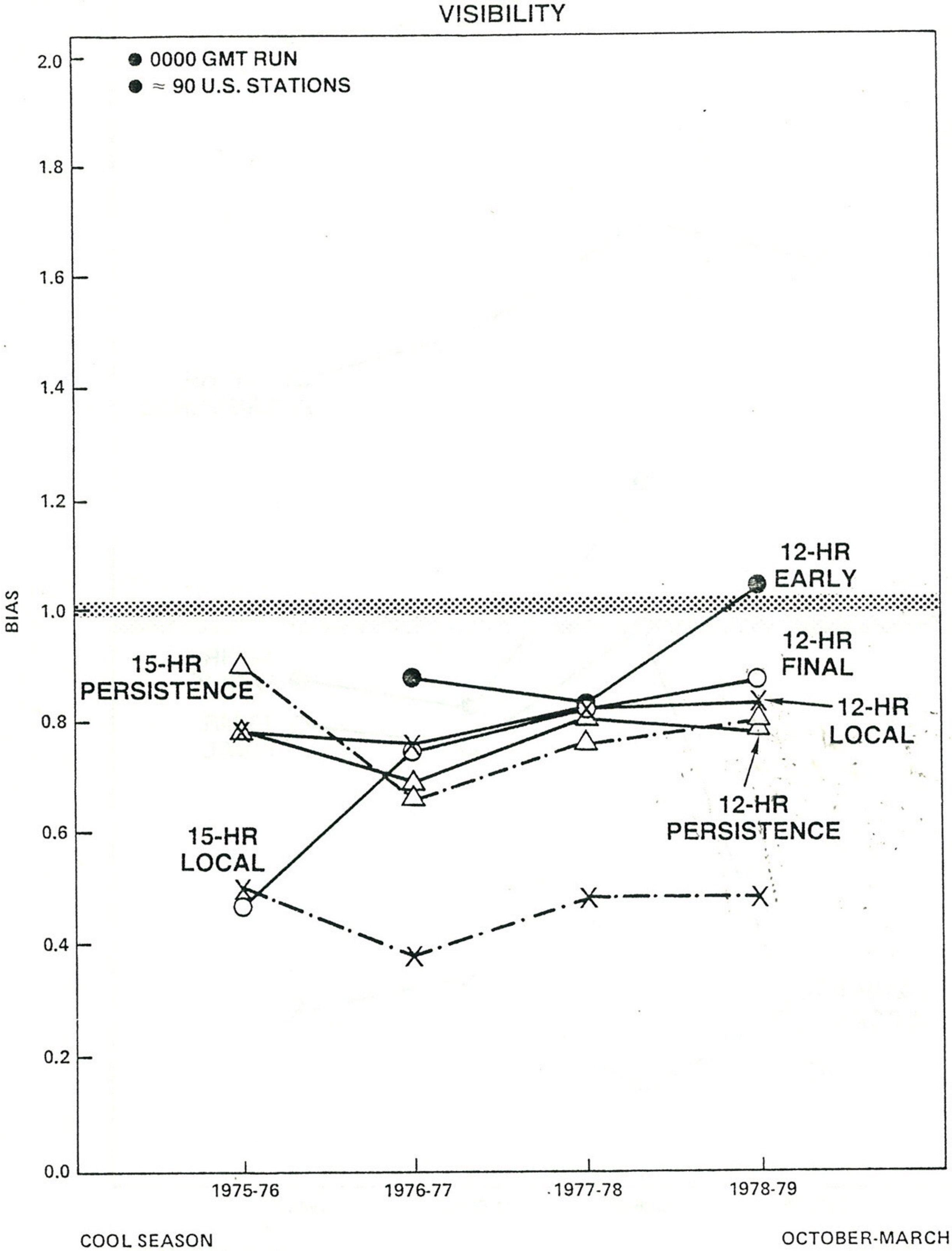

Figure 6.7. Same as Fig. 6.5 except for visibility forecasts.

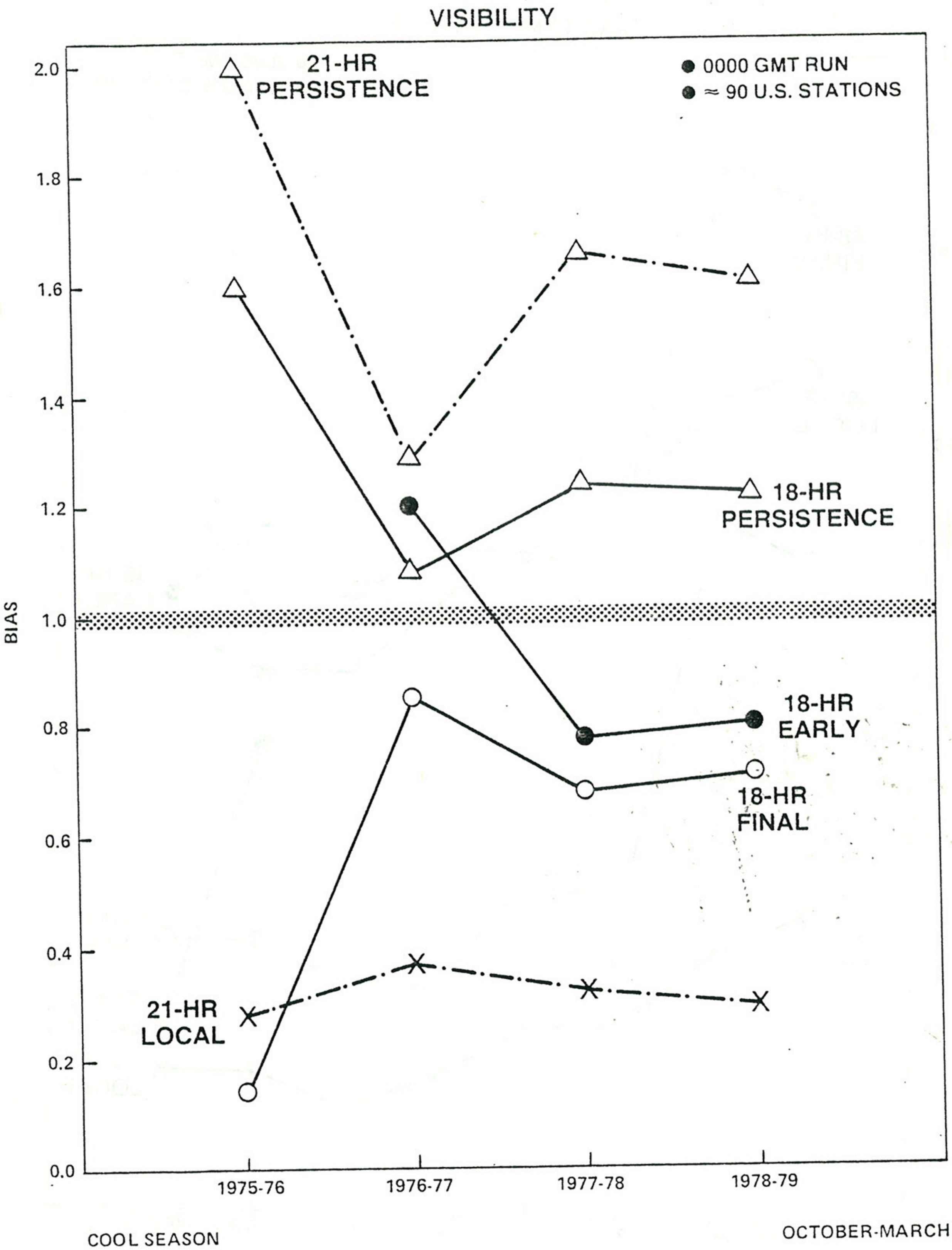

Figure 6.8. Same as Fig. 6.7.

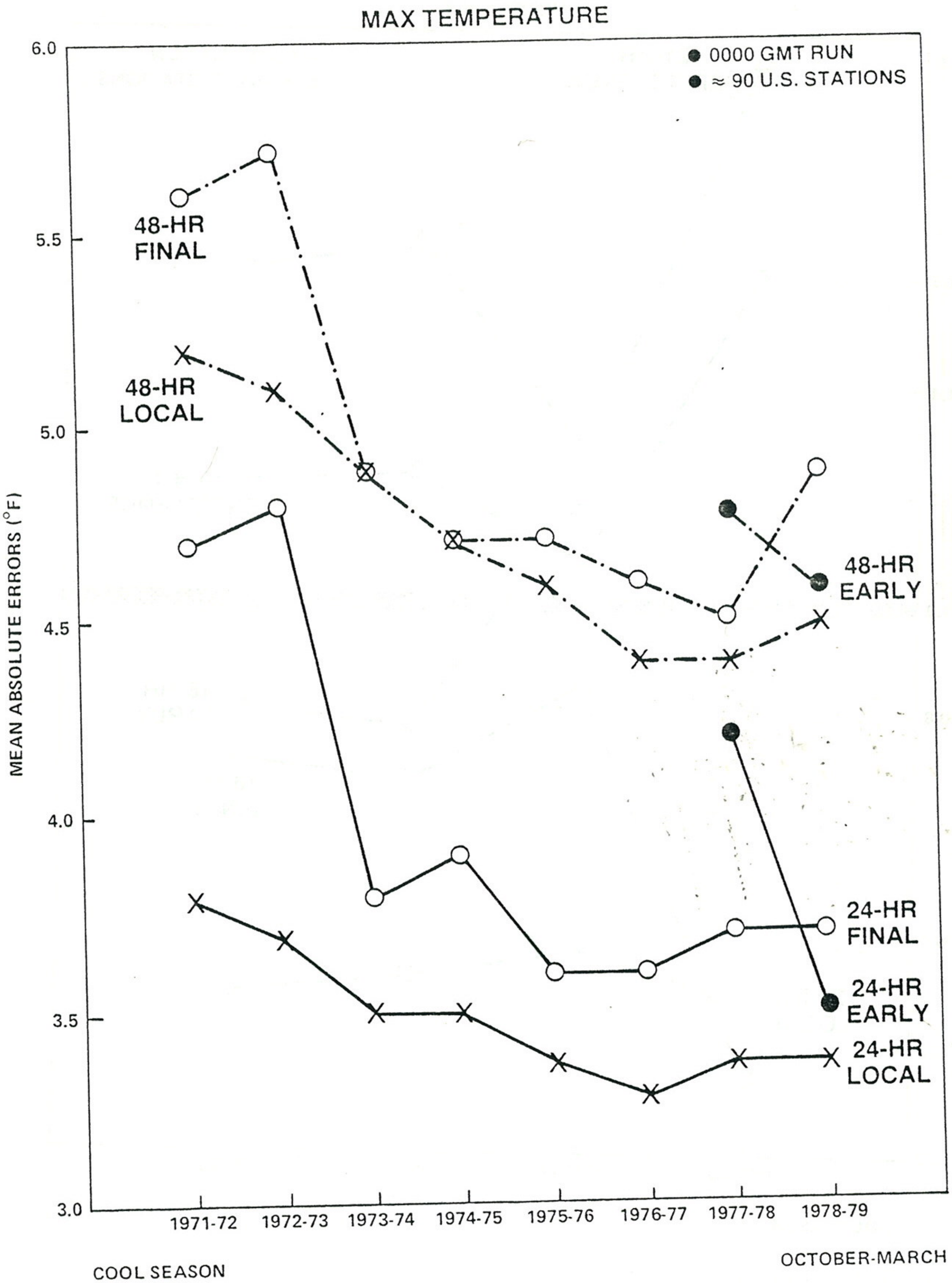

Figure 7.1. Mean absolute errors of the local and the objective temperature forecasts.

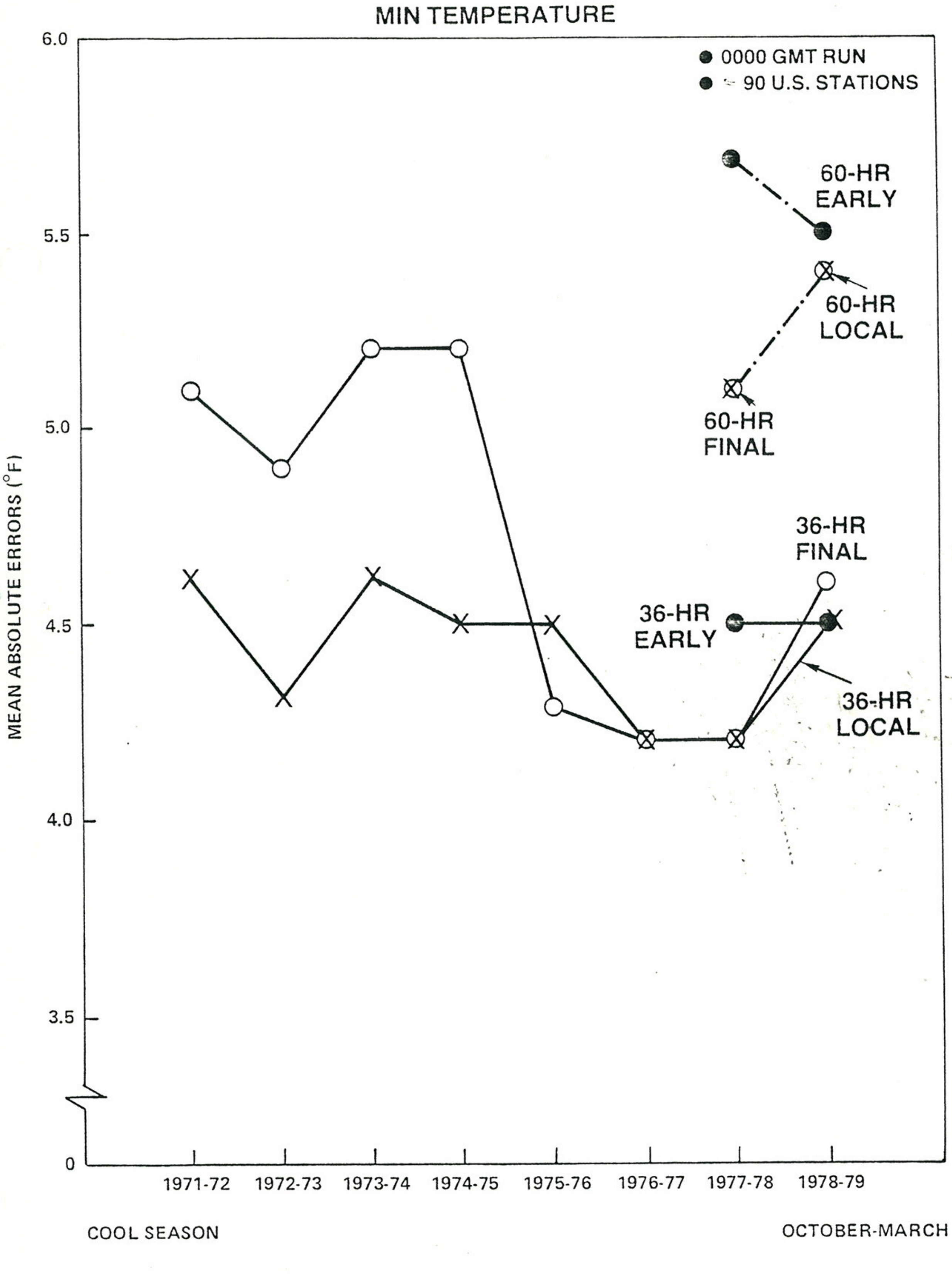

Figure 7.2. Same as Fig. 7.1 except for the min temperature forecasts.